POWER

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ELY C. HUTCHINSON, *Editor*

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Merry Christmas

ONCE AGAIN on behalf of *Power* and those who have to do with its making I extend to all to whom these pages may come our hearty wishes for a full infusion of the Christmas spirit and a plenteous measure of Yuletide joy.

Santa Claus is abroad in the land undisturbed by the consciousness that some little ones who are looking for him with so much faith and happy anticipation must go through their period of disillusionment. He knows that in the loving, sacrificing thoughtfulness of parents and friends, in the generosity of those whose hearts go out to the less fortunate, in the genial, holiday atmosphere of cheeriness and good-will they will re-find the realities of which his jocund personality is but the idealization.

To the awakened willingness to give there are this year more than the ordinary number of appeals. Some time our highly endowed leadership may become sufficiently enlightened to so correlate man-power with opportunity that the need for charity will be confined to those who have suffered physical disability and not include those who have all the willingness and capacity for self-support but who have been shouldered away from a place at the bench.

F. R. Low

EDITORIALS

What Price Politics?

SHALL it come to pass that a highly technical and specialized service of the federal government will be politically controlled? Is the price of a Federal Water Power Commissioner's job to be supine acquiescence to political expediency? Just what some of the Interstate Commerce Committee were out to accomplish by their attitude toward certain of President Hoover's nominees for the Federal Power Commission and in their effort to oust the executive secretary, F. C. Bonner, is not *Power's* business. But *Power* is deeply concerned with the integrity of the engineering profession and the possibility of political interference with legitimate business procedure.

Perhaps the politicians feel that the administration of the Federal Power Commission has not had enough politics, that it has been too business-like. But even this would not excuse the method of subjugation attempted during the interrogation of George Otis Smith by the gentleman from Montana.

Senator Wheeler has evidently succeeded in so disgusting the executive secretary, a faithful and efficient public servant, as to make him ask for transfer to some other department, as is his right under the civil service rules.

He did not succeed, however, in getting George Otis Smith to commit himself in advance as to the conduct of the office to which he has been nominated, despite the fact that his confirmation lay, to a considerable extent, in the hands of his interrogator.

For this at least, the engineering profession and the country as a whole are certain to be grateful.

Small Steam Turbines

A MANUFACTURER recently stated that in the field of small turbines the trend is toward cheaper and less efficient units. While this probably does not apply to the small turbine field in general, it does indicate that this manufacturer and his customers realize an expensive and efficient turbine is not always the most economical prime mover to install.

Where the demand for process or feed-heating steam is always in excess of that available from the turbine exhaust, the steam rate of the turbine is of little importance. A lower steam consumption makes necessary a corresponding increase in the live steam used for process, and no saving in fuel results. Under these conditions the higher price of an efficient turbine represents a waste of money and increases the overhead burden. Situations such as this are not unusual in industrial plants.

As a drive for power plant auxiliaries the small turbine must be an efficient machine—one that can compete with the efficiency of the main unit in the same pressure range.

As long as engineers recognize that there is a field for both the cheap, less-efficient turbine and the more expensive, efficient unit, the trend can hardly be toward one or the other of these types.

Low Vacuum Possibilities

THE VACUUM of 29 inches, or thereabout, has so long been standard in condensing station practice that it is taken for granted. This is unfortunate, for it directs thought away from the economic possibilities of low vacuum.

The mere suggestion may seem like a step backward, yet there has always been a field, even with steam turbines, for much lower vacuum. Today the practical development of high pressures has opened possibilities in this connection that did not exist before.

An example—previously mentioned in *Power* but worth bringing up again—is the mine-mouth plant. Not many years back the popular clamor for mine-mouth plants was triumphantly silenced with the mysterious phrase, "what about condensing water?" One must, perforce, have a stream at the mine mouth, it was

assumed. Moreover, the available power must be computed on the basis of minimum stream flow and a high vacuum—28 in. at least.

Possibly too much was taken for granted in those analyses. Certainly, today, with high steam pressures, the matter demands reconsideration. It may pay to sacrifice high vacuum to get the benefit of cheap coal, particularly when high initial pressure reduces the importance of vacuum. In fact, it is conceivable that the long-slighted cooling towers or ponds deliberately operated with a low vacuum might prove an ideal economic solution in such cases. By allowing a considerable absolute back pressure, the size and cost of the complete condensing equipment would sink to insignificant proportions. Thus condensing water supply may cease to be the major consideration in mine-mouth power stations.

This is not offered as a definite solution of the problem of mine-mouth plants. There are many other factors, notably transmission costs. It *is* a definite plea for a reopening of such problems in the light of new developments. Nothing is accomplished by the closed mind.

Erosion in Low-Pressure Blading

A TROUBLESOME factor in steam turbine operation with moderately high pressures has been erosion of the last few rows of blading. This is explained by the fact that the steam during expansion from its original condition has crossed the saturation line and contains appreciable moisture when passing through the last stages. Designers endeavor to limit this moisture content to a maximum of ten per cent at the exhaust. However, if the initial superheat is below that specified for the unit, due to boiler operating conditions, moisture may exceed ten per cent. Increased turbine efficiency also increases the wetness at exhaust and thereby aggravates the trouble.

The late Professor Goodenough showed that such moisture in the form of droplets travels through the nozzles or stationary blades of turbines at a velocity only about one-eighth that of the accompanying steam. Consequently, while the mixture may enter the succeeding low-pressure blade, which, incidentally, has a high peripheral speed, with the correct velocity ratio for the steam, the ratio is by no means correct for the moisture. Hence the rear flank of the blade entrance strikes these droplets with great force. This continual impact causes rapid erosion of the inlet edge of the blade, usually starting from the rear side. A second impact may occur on the flank of the leaving edge of the blade with equally disastrous results.

Blade erosion increases outage and the cost of repairs and maintenance. It also lessens the reliability and availability of the unit. Hence serious consideration has been given to means of alleviating this trouble.

Many new alloy steels, and even non-ferrous alloys, have been tried for low-pressure blading with some success. The stainless steels and certain nickel-copper alloys appear promising. Their use has increased first cost, and in some cases the toughness and other desirable properties of the carbon steels have been sacrificed.

One of the British turbine builders has developed a new method for protecting these low-pressure blades. They are made of rolled carbon steel, properly heat-treated, and a thin sheath of hard high-chrome alloy steel, pressed to the exact form of the blade, is slipped over the outside and brazed or silver-soldered to the blade. This sheath appears to be highly resistant to erosion, and reports from actual service indicate that it may have several times the life of ordinary blading.

Turbine engineers will be interested in the experiences gained in service with this new form of blading, and will welcome further developments in this or similar lines that will insure longer life to low-pressure blading.

Control Equipment As a Labor Saver

THE VISITOR to a modern ice plant finds its equipment and operation radically different from that existing ten years ago. While the compressor and its drive are new, the greatest departure from former practices is in the control equipment.

Ice distribution problems made the large plant obsolete. It has been replaced by smaller, more centrally located plants, which, although lowering haulage expense, increased the plant labor until control devices were introduced to replace manual operation.

Not only has labor been reduced but the automatic equipment has enabled the machine efficiency to be improved, for hand control is far inferior to the instantaneous response of reliable instruments to a change in conditions.

For this reason, even in plants where future labor savings are impossible, the installation of more automatic control devices will often be reflected in a reduction in power costs or an improvement in output.

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POWER Stands for . .

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**
8. **Prevention of Smoke, Within Reason**

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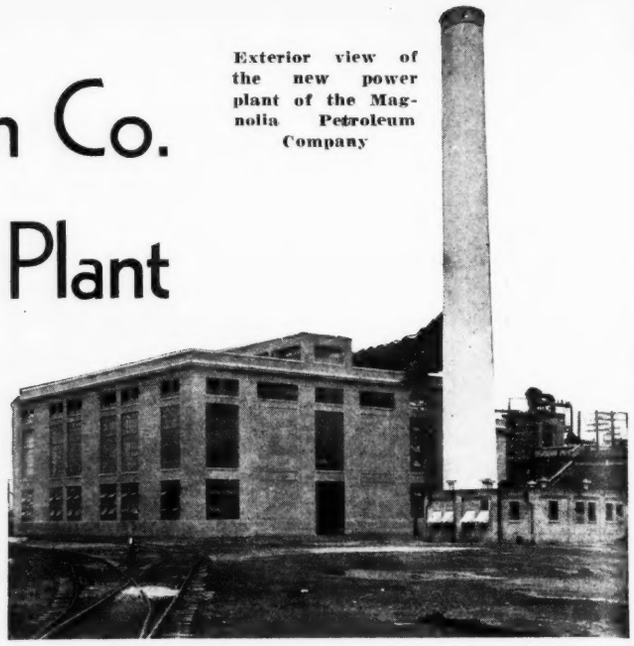
Magnolia Petroleum Co. Builds New Power Plant

At Beaumont, Texas



Exterior view of the new power plant of the Magnolia Petroleum Company

By G. G. HOLLINS
Mechanical Engineer
The J. G. White Engineering Corp., New York

An example of a modern industrial power plant, generating both steam and electric power and making the latter as a byproduct of the steam for process. Two double-extraction and mixed-pressure turbines are employed and the boilers are designed to burn natural gas, fuel oil or acid sludge with provision for pulverized coke in the future

IN THIS plant the steam conditions are 385 lb. pressure at the turbine, and a temperature of 650 deg., with the turbine exhaust at 150 lb., 25 lb., and 10 lb. These pressures were required by conditions in the refinery. Also, the main turbines are arranged to receive steam from the 25-lb. exhaust system. Unlike the main steam turbines, which exhaust at the three above-mentioned pressures, the auxiliary turbines of the power house exhaust at only one pressure. Those driving the boiler feed pumps and the induced-draft fans exhaust at 150 lb., while the turbines connected to the spare exciter and the booster pump exhaust at 10 lb.

The boilers operate at ratings of 300 per cent and over and at 400 lb. pressure, with 100 per cent make-up, except for the small amount of steam condensed in the open feed-water heater. The water available for the boiler feed contains over 10 gr. of solids per gallon and, although not particularly hard, a considerable amount of organic matter and silica, which is largely in colloidal form and consequently difficult to remove. There is no condensed steam available for return to the boilers, and it was necessary either to design the boiler plant to operate with treated raw water or to install evaporators for the process steam. As the greater part of the process steam is required at 150 lb., the use of evaporators would have greatly increased the cost of the plant not only in the cost of the evaporating equipment, but also by requiring higher steam pressures to maintain the heat balance and to obtain the necessary temperature difference to operate the evaporators. It was therefore decided not to use evaporators and to design the plant for operation with treated water.

There are a number of fuels available at the refinery. The boilers were designed for initial operation with natural gas, fuel oil or acid sludge. Provision was also made for later installation of equipment for pulverizing and burning refinery coke. The acid sludge and coke present a disposal problem in the refinery and, of course, are not so desirable fuels as the natural gas or the fuel oil. Difficulties due to the acid contained in the sludge are also likely to arise, hence the temperature of the flue gases must be kept well above the dew point so that there will not be any condensation of the acid.

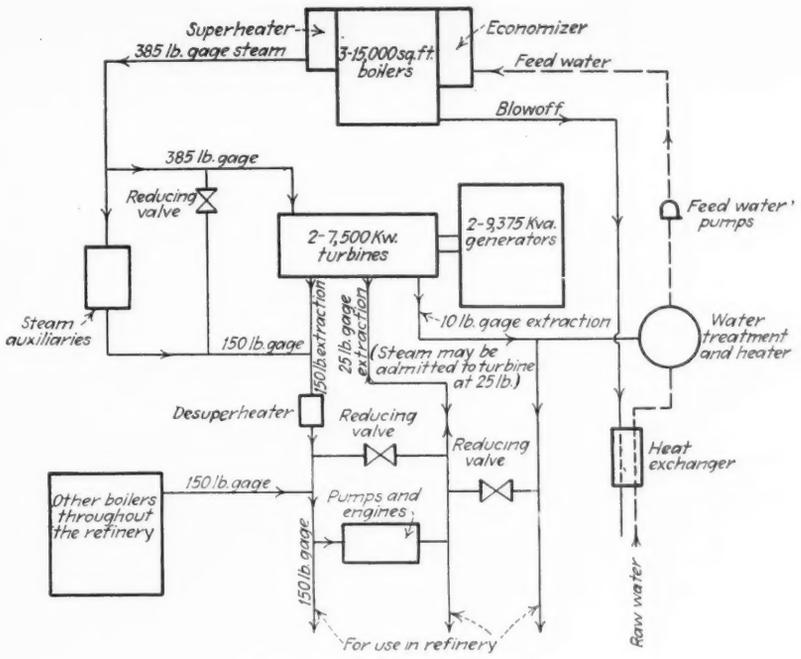
At present two 7,500-kw. turbine-generators and three 15,250-sq.ft. boilers are installed. The building has a steel frame with brick walls and precast stone trimming. Space has been provided in the boiler room for three additional boilers, as it is expected that they will be required in the near future. The firing aisle was made wide so that pulverizers may be installed to use refinery coke, and the building steel provides for a coke bunker.

The boilers are of the four-drum bent-tube Stirling type, designed for a maximum working steam pressure of 425 lb. They are equipped with convection-type superheaters, giving a total steam temperature of 650 deg., and each boiler has a steel-tube economizer containing 6,720 sq.ft. of heating surface. The size of the economizers was chosen after studying the effect of the cheap fuel, and while the over-all boiler efficiency could have been made higher by larger economizers it would not have been economical under the conditions. There would also have been the possibility of reducing the exit gas temperature to a point where there would be bad effects from the acid content.

Because of the use of raw water in the boilers and acid fuel, it was decided not to use water walls. The settings

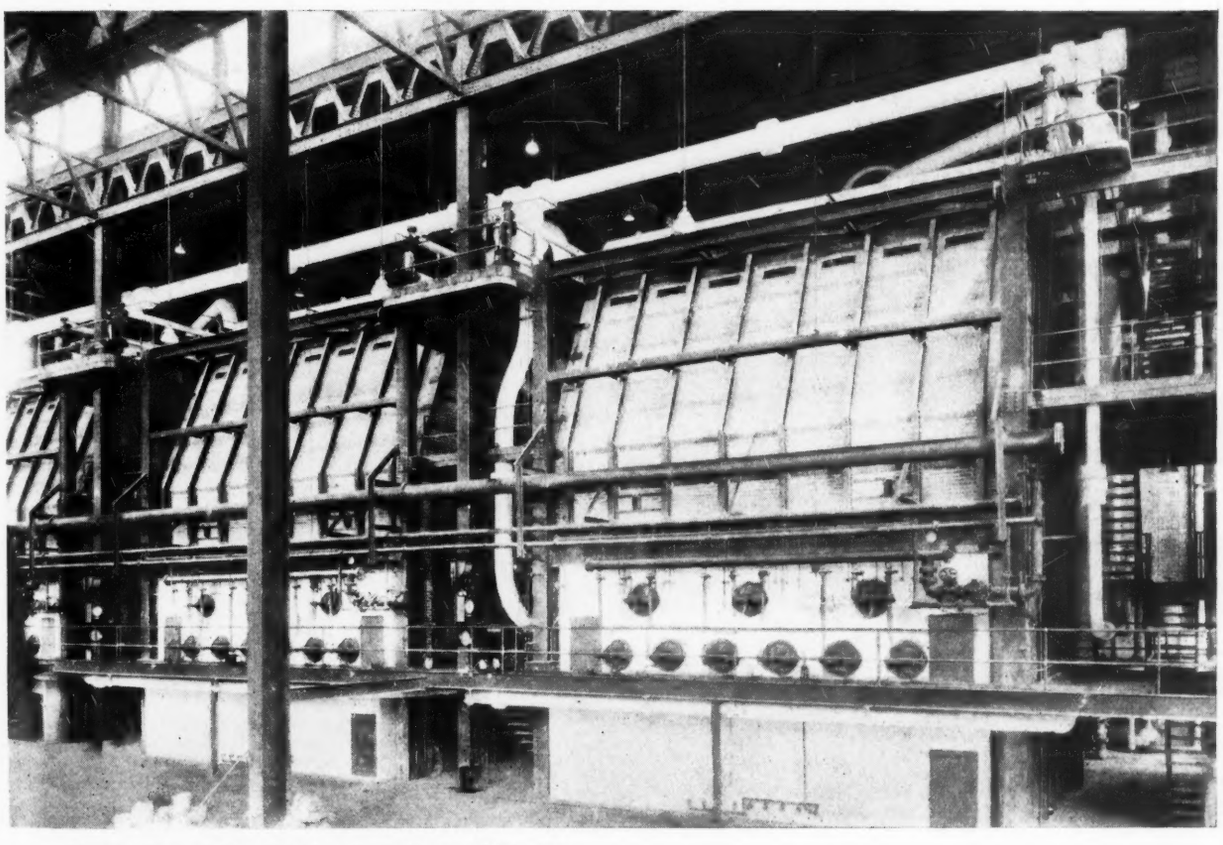
have air-cooled side walls and furnace bottoms and were designed for the use of the four fuels mentioned previously. Furnace volumes have been made large so that high ratings can be carried continuously. The wide furnaces also expose a large amount of the boiler surface to the direct heat of the furnace and the radiation from the furnace walls. The furnaces were designed to develop 300 per cent rating of the boilers and have already been operated at approximately 340 per cent rating for over eight hours, or an actual evaporation of 150,000 lb. of steam per hour per boiler.

The burners are mounted on the front wall of the boilers and are combination gas, mechanical oil burning and steam atomizing. Steam atomizing was selected because acid sludge contains large solid particles, which will quickly stop up a small orifice such as employed in mechanical burners. It is useless to strain this sludge, as the solid material forms a very large proportion, and if it were removed it would be equivalent to dividing the sludge into two fuels for separate disposal. The sludge being a waste product that must be disposed of, it was decided that its combustion should be made as simple and convenient as possible rather than try to obtain high efficiency with it. For this reason a specially designed steam-atomizing burner was used having large passages for the sludge and allowing particles of considerable size to go through. It is expected that when pulverized coke is burned additional burners will be installed, and place has been left for them.



Power plant steam-flow diagram

Each boiler is provided with two motor-driven forced-draft fans and one steam turbine-driven induced-draft fan. The forced-draft fans draw the air through the air-cooled walls and furnace bottom and discharge through a duct under the boiler to the burner windbox



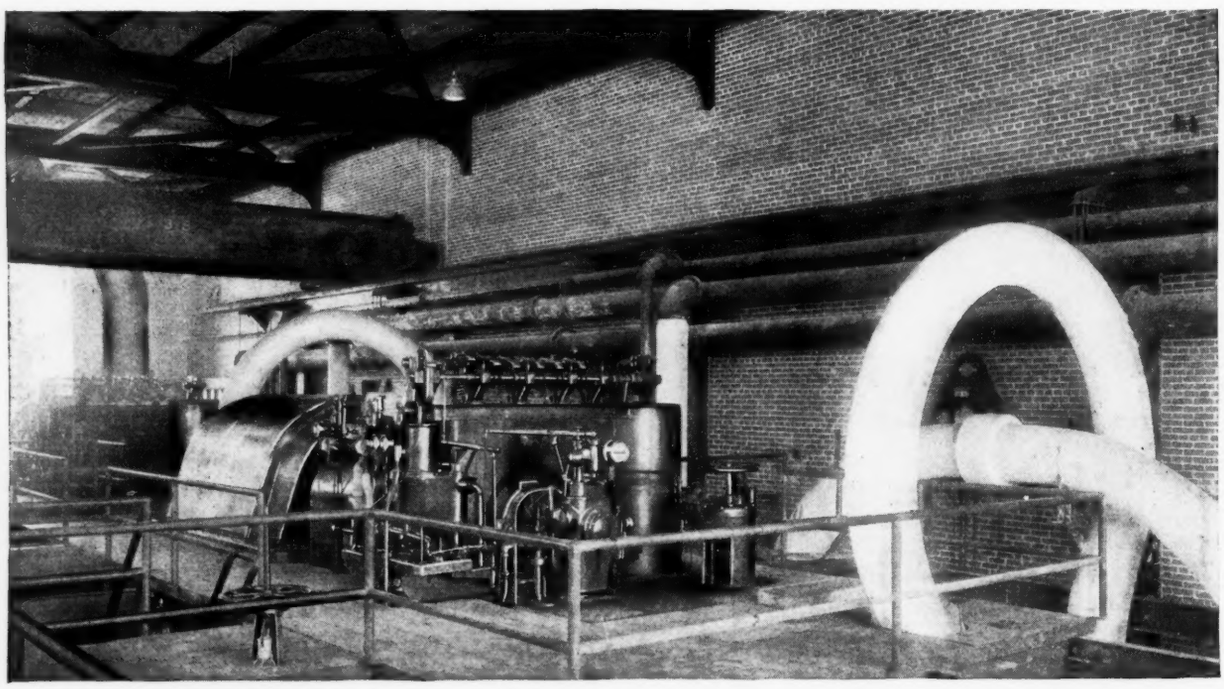
Front view of the 15,250-sq.ft. boilers, which are designed to burn natural gas, fuel oil or acid sludge

Principal Equipment Magnolia Petroleum Company

Boilers:	
Manufacturer	Babcock & Wilcox Co.
Type	Stirling
Number	3
Heating surface, each, sq.ft	15,250
Steam pressure, maximum, lb. gage	425
Superheaters:	
Manufacturer	Babcock & Wilcox Co.
Superheat	225 deg. F. at 300 per cent rating
Economizers:	
Manufacturer	Babcock & Wilcox Co.
Type	Return bend loop
Heating surface, each, sq.ft	6,720
Soot blowers	Diamond Power Specialty Corp.
Furnaces, air-cooled walls	M. H. Detrick Co.
Burners:	
Air registers, gas and mechanical oil	Bethlehem Steel Co.
Steam atomizing	Magnolia Petroleum Co.
Number of air registers per boiler	9
Draft Equipment:	
Fan manufacturer	Buffalo Forge Co.
Number per boiler: Forced-draft	2
Number per boiler: Induced-draft	1
Capacity: Forced-draft, each, c.f.m at 250 deg	40,000
Capacity: Induced-draft, c.f.m., at 450 deg. F	110,000
Drive, forced-draft, 60-hp., 1,200 r.p.m., constant-speed induc. motor	Westinghouse
Drive, induced-draft, 140-hp. turbine with reduction gear	General Electric Co.
Stack:	
Vendor and erector	Alphons Custodis Chimney Construction Co.
Number and type	1 concrete
Diameter, inside, at top	12 ft. 6 in.
Height above foundation	175 ft.
Turbine-generators:	
Manufacturer	General Electric Co.
Number	2
Capacity, each	7,500 kw.
R.p.m.	3,600
Steam at throttle	385 lb., 650 deg. F.
Automatic steam extraction pressures	150 and 25 lb. gage
Exhaust pressure	0 to 10 lb. gage
Mixed-pressure admission	25 lb. gage
Generator	9,375 kva., 3-phase, 60 cycle, 2,300 v.
Exciter	Direct-connected
Generator air coolers	General Electric Co.
Boiler-Feed Pumps:	
Manufacturer	Allis-Chalmers Mfg. Co.
Number and size	3—4-stage, 1,200 g.p.m.
Driving turbine, 550 hp.	Terry Steam Turbine Co.
Feed-Water Treatment:	
Hot-process water softener	
Manufacturer	Cochrane Corp.
Capacity, gal. per hour	70,000
Pumps:	
Booster pumps, 2,—1,200 g.p.m. (Cameron) 1 with G.E. turbine and 1 with Westinghouse motor	Ingersoll-Rand Co.
Wash-water pump, 1,—2,400 g.p.m. (Cameron) motor-driven	Ingersoll-Rand Co.
Cooling-water pumps, 2,—500 g.p.m	Goulds Pumps, Inc.
Phosphate proportioning pumps, 12 gal. per hour	Hills-McCanna Co.
Piping:	
Main steam, blowoff, main and auxiliary exhaust	Power Piping Co.
Boiler feed	W. K. Mitchell Co.
Motor-operated valves	Chapman Valve Mfg. Co.
Gate valves, steel	Chapman Valve Mfg. Co.
Gate valves, large, low pressure	Chapman Valve Mfg. Co.
Non-return valves	Edward Valve & Mfg. Co.
Globe valves, high pressure	Consolidated Ashcroft Hancock Co.
Safety valves	Consolidated Ashcroft Hancock Co.
Turbine relief valves, 10-and 25-Lb. lines	Atwood & Morrill
Reducing valves	Ruggles-Klingemann Mfg. Co.
Designing engineers	J. G. White Engineering Corp.

in front. For simplicity, these forced-draft fans are driven by constant-speed motors, and the control is by dampers. The induced-draft fan takes the gases from the economizer and discharges to an overhead breeching connected to a concrete chimney. This chimney is 175 ft. high and has an acid-resisting lining from the breeching opening to the top. The driving turbine of the induced-draft fan is controlled by a regulator to maintain a condition of constant pressure in the boiler furnace.

The water-treatment plant consists of a hot-process system with a jet heater on a sedimentation tank, and filters for the treated water. It has a capacity of 70,000 gal. per hour, which is somewhat greater than present requirements. An after-condenser is provided so that the jet heater may be freely vented without the waste of exhaust steam. The heater and sedimentation tank are designed to operate with exhaust steam at 25 lb., and the piping is arranged so that steam may be supplied



The 7,500-kw., double-extraction, mixed pressure turbine-generator units are designed for steam at 385 lb. pressure and 650 deg. temperature

at either 25 or 10 lb. The combination of the jet heater and the ferrous sulphate used in the water treatment results in the water being completely deaërated, as demonstrated by frequent routine tests.

Adjoining the heater tank and filter is a small building containing the chemical proportioning equipment and supply of chemicals. This building also contains the filter wash-water pump and booster pumps for boosting the supply water pressure. On account of the characteristics of the water and the boiler pressure, sodium phosphate treatment is used. However, instead of adding the phosphate solution in the sedimentation tank, it is pumped directly to the boilers by individual high-pressure pumps. This treatment has shown effective results, as the boilers, when opened, have been entirely free from scale. From the filters the water goes to the boiler-feed pumps, which are driven by turbines exhausting at 150 lb. To provide against any failure of water supply or trouble with the treating equipment an ample supply of treated water is held in reserve in a tank. There is also being installed a spare heater so that this treated water may be heated and deaërated before being used in the boilers. To control the concentration in the boilers the blowdown must be large, and because of the temperature of the water it contains a considerable amount of heat. The continuous blowdown system is used, and to prevent loss of heat and water is passed through a heat exchanger, where it is cooled by the water supplied to the treating plant.

The piping was laid out to keep the plant operating under all conditions and has been looped or sectionalized so that a part of the plant can be shut off for repairs without disturbing the remainder.

The 7,500-kw. turbine-generators have direct-connected exciters and are of the double-extraction and mixed-pressure type, exhausting at 150 lb., 25 lb. and 10 lb. and taking steam at 25 lb. These units are designed for steam at the throttle at 385 lb. pressure and 650 deg. temperature. They operate at 3,600 r.p.m. The generators are rated at 2,300 volts, 3 phase, 60 cycles, 80 per cent power factor, and are provided with a closed cooling-air system.

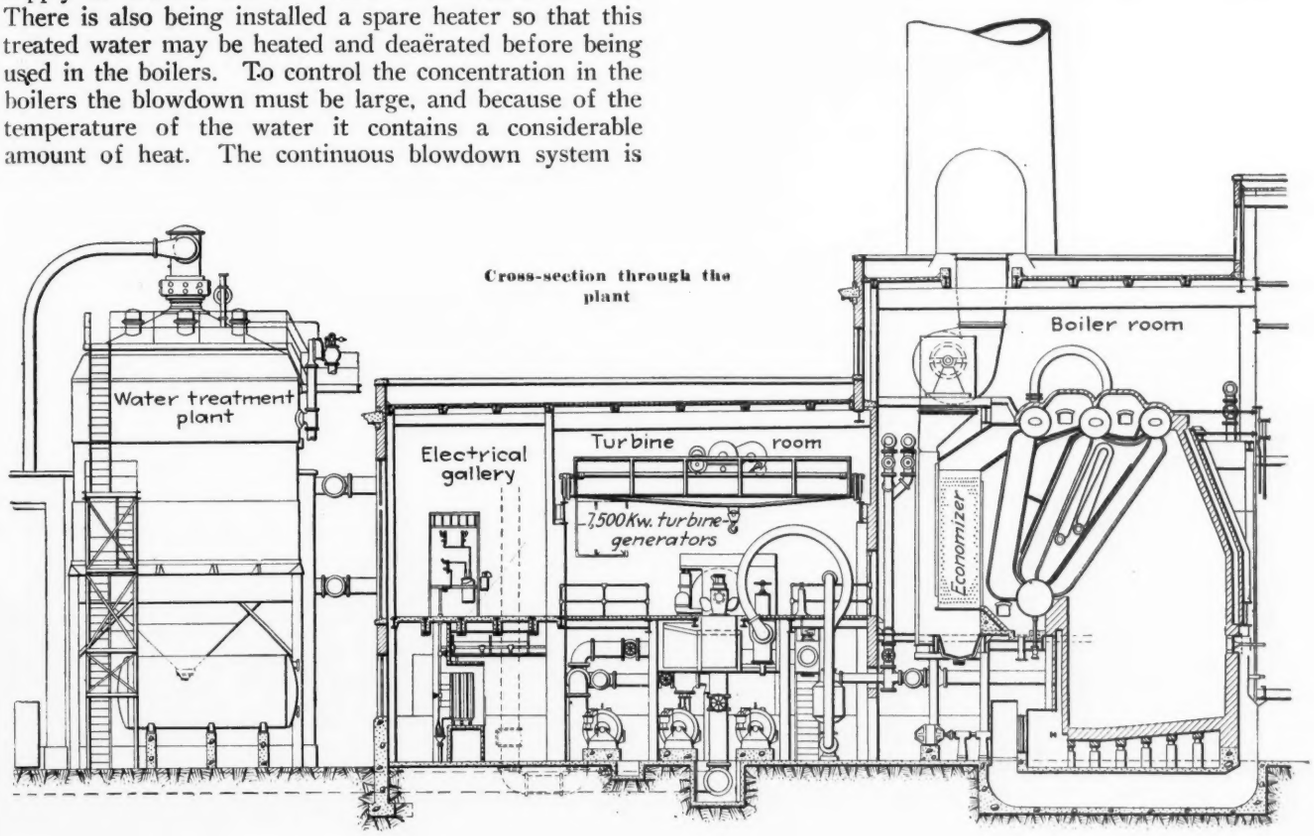
As the electrical load on the turbine-generators limits the amount of steam that may be extracted at 150 lb. from the main turbines, reducing valves are provided to supply the additional steam required directly from the boilers. There are two sets of reducing valves on opposite sides of the main sectionalizing valves. The 150 lb. steam from the reducing valves and that from the turbines must be desuperheated for general use, but the desuperheaters are located in the outside steam mains, as there are some branches taken off before desuperheating.

Features of the electrical design are the main voltage of the generators and the auxiliary voltage. The main generator voltage was restricted by conditions in the refinery, and it was necessary to install very heavy copper conductors and heavy circuit-breakers as a result of the size of the generators and the low voltage.

The electric auxiliaries are supplied at 440 volts from a house transformer, as the use of the generator bus voltage for the large motors would have required very heavy and expensive circuit-breakers and 220 volts would have been too low for them. The 440 volts works out well for both the large and small motors and has the further advantage of being the same voltage as used for the motors in the refinery.

The switching equipment, consisting of control board, field board, 2,300-volt structure and 440-volt auxiliary board, all of steel cubicle construction, probably is the first complete installation of this type. The cubicles, including those of 3,000-amp. rating for the generators, were completely assembled in the factory and were shipped ready to set on the foundations. The control board has panels arranged back to back with the rear panels hinged. Square instruments are used on the panels.

Cross-section through the plant



By DAVID J. GITTO

Inspection Division
Aetna Casualty & Surety Company

A flash light or an extension lamp should be used to make the ropes' condition easily visible when inspecting them

When and How To Inspect Elevator Ropes

No part of an elevator requires more careful attention than the ropes. In this article an elevator engineer of many years' experience tells how to make these inspections and where the weak spots in rope are usually to be found

ROPE INSPECTION of passenger and freight elevators is an important factor in their safe operation. These ropes are subjected to a wide variety of conditions, such as types of machine, size of sheaves, atmospheric conditions, height of rise, car speed, kind of service, and others, all of which must be taken into consideration when making inspections. The various makes of ropes do not all act alike in a given service. Even two sets of ropes of the same make may perform radically different under apparently identical conditions. One may have long life, while another may become unsafe a few months after installation. Therefore the time that ropes are in service cannot be taken as a guide to their safe condition. Some ropes may show only a few wires cracked on the outside but fail unexpectedly in service, and then be found to have many inside wires cracked that could not be seen without unlaying. Other ropes fail for no explainable reason. All of which emphasizes the importance of careful periodic inspections.

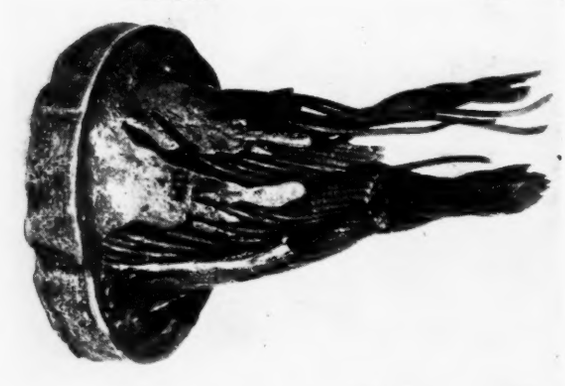


Fig. 1—Elevator rope terminal at which three strands have failed inside the socket

The first essential to rope inspections is that the one doing the work be thoroughly competent. A rigid examination should be made of the ropes at each inspection. This examination cannot be too thorough, for safety of life and property is dependent upon the condition of the ropes. If, upon an inspection, recommendations are made for the renewal of certain ropes and there is a difference of opinion as to the necessity of doing so, the matter can best be adjusted by a joint inspection by all parties interested. Ropes on passenger and combination passenger and freight cars must be inspected at least every 3 months.

On drum-type elevators, with the hoisting machine in the basement, Fig. 2, the ropes are inspected from four locations: the machine room, the overhead work, on top of the car and in the hoistway pit. The work should be done in the order named. Less than one-half of the hoisting and drum counterweight ropes wind on the drum, consequently they cannot be completely inspected from the machine room. On the other hand, the part of the drum counterweight ropes that wind on the drum cannot

be inspected from the top of the car. Beginning the inspection in the machine room, have the operator start the car from the bottom landing and make runs of 4 or 5 ft between stops. At each stop the inspector examines the ropes on the drum and also the hoisting ropes where they come down back of the drum. The latter requires particular attention, because it is the side of the hoisting ropes next to the inspector that makes contact with the drum and is most likely to show wear and cracks.

The drum counterweight ropes come in under the vibrating sheave on to the drum. On account of the reverse bend made around the sheave these ropes wear more quickly than the car-hoisting ropes. The cracks in these ropes will generally appear on the outside of the turns on the drum. When making this inspection examine the rope connections to the drum to see if they are made properly. Also note if the vibrating sheave moves freely on its shaft and does not lag and cause the ropes to rub on one side of the drum's grooves.

After completing the rope inspection in the machine room, have the operator come to the lower landing, get into the car and go to the top floor. Have the operator keep the car in this position and go up into the overhead work and inspect the sections of the ropes that cannot be reached from the top of the car.

When the inspection is completed in the overhead work, get on top of the car and have the operator move the car up slowly as far as it is safe and examine the ropes from that location. After this have the operator make stops at about 3 or 4 ft. in the down direction and inspect all rope while making the down trip. The ropes should be examined both front and back. An extension light or a flash light should be used to make the rope easily visible. It is not recommended that the ropes be twisted by hand so as to bring the side next to the wall into a position to be seen by the inspector. Use a small mirror to see that side of the ropes. A mirror offers a surer way of thoroughly inspecting the ropes and finding defects if there are any.

Some inspectors allow the ropes to run through their hands, to feel the defects and in this way speed up the inspection. Other hold a piece of soft wood or a handful of waste against the rope while they are in motion to pick up broken wires. None of these expedients can be relied on to determine rope's condition. There is no substitution for a careful visual inspection by an experienced man.

The drum counterweights are located under the car counterweights, consequently the ropes for the former pass through the latter. To protect these ropes from abrasion, where they pass through the car counterweight, tubes are placed on them. See that these tubes are properly set and make certain that the clamps on the top ends of the tubes will pass through the holes in the car counterweights. If they cannot, and the drum counterweight ropes break, this counterweight will hang on to the car counterweight and the weight of the two will pull the car into the overhead work, with disastrous results.

See that there is at least 6 in. of space between the car and drum counterweights. If a new set of car counterweight ropes is installed and sufficient space has not been left between the two sets of counterweights, the car counterweight rope may stretch to where the top counterweight rides on the bottom one.

Connections to both the counterweights should be carefully inspected. If there is any doubt about these con-

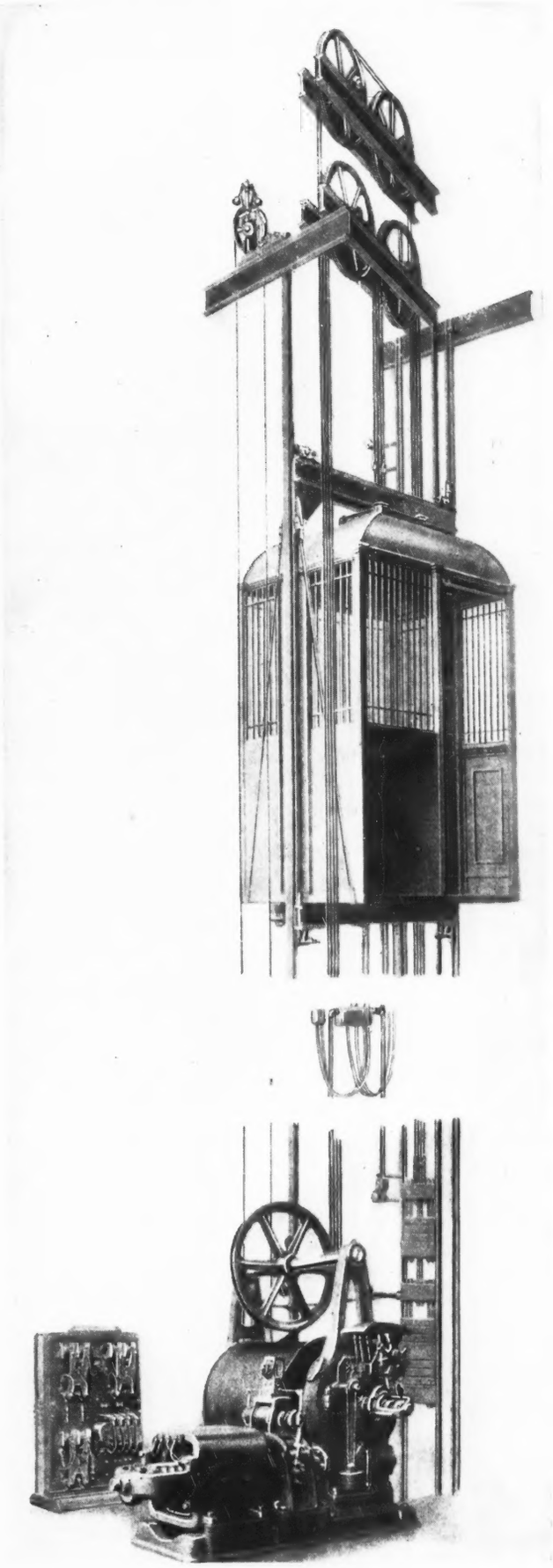
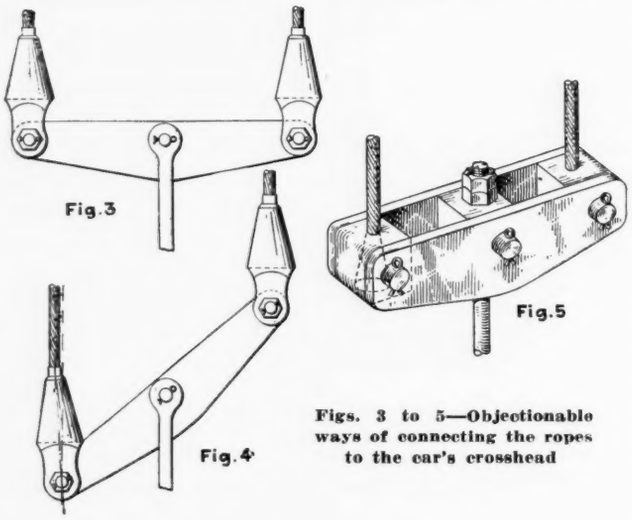


Fig. 2—Drum-type elevator with the hoisting machine installed in the basement

nections a recommendation should be made to have them exposed so that a thorough examination can be made. Ropes have been known to break unexpectedly at the terminals. Any vibration in the ropes is reflected to the terminal connections and creates bending moments that may fatigue the wires and eventually break them. When the terminals are put on to the rope the job may be im-



Figs. 3 to 5—Objectionable ways of connecting the ropes to the car's crosshead

properly done or the ropes may be injured; therefore the inspection of these parts cannot be too carefully made. Fig. 1 shows a terminal taken from an elevator rope. Three of the strands had completely failed. In two other strands only ten wires in each remained intact, and although all the wire in the sixth strand remained in place, several of them were cracked inside the terminal. When inspecting the connections at the counterweights include those on the compensating ropes or chains, if there are any.

The method of connecting the rope to the car crosshead is a big factor in the strains produced in them at these terminals. Attempts have been made to equalize the loading on the ropes by using equalizing bars, as in Figs. 3 and 4. There are two serious objections to the use of such equalizers. First, the rope terminals are connected close to the bar. This allows swinging of the ropes to produce severe strains where they come out of the terminal connections. When the equalizer bar moves, leverage between the ropes and the bar is so short that the ropes may be bent at the top of the connections.

There have been instances where a difference in the length of the two ropes connected to an equalizing bar allowed one of the terminals to bind on the bar so that it could not line with the rope, as indicated in Fig. 4. This condition causes severe strains in the rope at the end of the socket. To remedy the condition have both ropes cut of equal length at the equalizer bar, and resocketed to bring the bar horizontal. Never permit the ropes to be equalized by pulling them in at the drum, nor allow only one rope to be cut and resocketed.

Terminals of the type in Fig. 5 are even more objectionable than those in Figs. 3 and 4. The sockets are supported from the center; consequently the ropes have very little leverage to hold the former in line. Sometimes the socket connections to the equalizer bars become rusted and stick; then any movement of the bars puts a sharp bend in the ropes at the edge of their sockets. If this condition is not discovered there is danger of the ropes failing at the terminals. Long terminals, as in Fig. 6, are the preferred method of connecting the ropes to the car's crosshead. These will easily deflect and ease the strain at the sockets caused by vibration of the ropes.

It is desirable that all rope have equal tension. On traction machines with five or six hoisting ropes it is practically impossible to maintain equal tension in them without an automatic equalizer, as in Fig. 7. With this device the ropes are equalized in pairs on equalizing bars and the loading on each pair of ropes is distributed by an equalizing rope in the car's crosshead. The rope terminals are connected to the equalizing bars by long connections, so that little bending strain is placed on the ropes at their sockets. It is also advisable to use automatic equalizers on the compensating ropes of traction elevators, as the short life of some of the ropes would indicate that they are subjected to conditions not generally realized.

After the inspection has been completed from on top of the car go into the hoistway pit and have the car lowered so that the safety drum can be reached. Unwind the rope of the drum to make sure that it has no injured places and that it is not jammed so that the safeties cannot function. While under the car the governor rope sheave should also be inspected to see that it is functioning properly and that its weights have sufficient clearance below them. If compensating ropes or chains are used, their connections to the bottom of the car should be checked.

On overhead drum-type machines the counterweights and governor ropes are inspected from on top of the car, but the hoisting ropes must be inspected from the machine room. The wear on these ropes is on the side next to the drum, which makes it difficult to see. A small mirror held back of the ropes facilitates inspection.

When working around the drum or sheaves or elevator machine during inspections, be careful not to place the

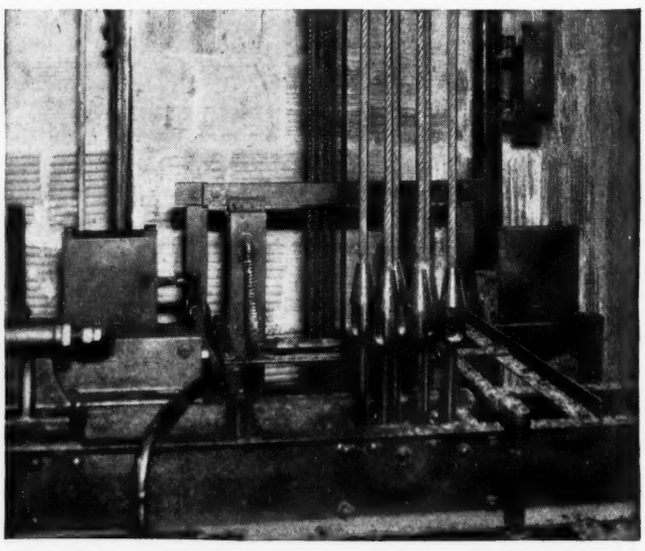


Fig. 6—Preferred way of connecting the ropes to the car's crosshead

hands on the drum and do not wear loose clothing that may be caught under the ropes. Serious accidents have occurred from these causes. Always make this inspection with the machine in the down motion, as the hoisting ropes are then winding off the drum.

On traction elevator machines the ropes may be inspected from the top of the car. With the car at the top landing the ropes are inspected by having the car

moved down a few feet at a time. Halfway down the hoistway the counterweights will approach the car. All rope connections to them should be carefully inspected; for the rest of the way down the hoistway the compensating ropes are inspected. From the position of the car at the top landing up into the machine room there is a section of rope that must be inspected from the overhead work. When the car is at the lower landing there is a section of the compensating ropes and the tail rope on the safeties that must be inspected from the hoistway pit.

As a rule when ropes are installed on a new job they are of the proper length; but after a few months they stretch to where it is necessary that they be shortened. Care should be taken to avoid shortening the ropes so that should the car run by its limit of travel it will not be pulled into the overhead work before the counterweights land. This might result in damage to the equipment and possible injury to those in the car. When the car platform is level with the top floor landing, there should never be more than 18 or 20 in. between bottom of counterweights and bumper springs, or bottom of the elevator pit when bumper springs are attached to counterweights. This condition should be checked from time to time.

The material from which traction-elevator sheaves are cast is supposed to be harder than the ropes that run on them, so that the grooves will hold their shape, while the wear is on the ropes. In some cases, on V-grooved sheaves, the ropes are so hard that they wear down the grooves and the ropes become bottomed therein. This causes the ropes to lose their traction and to slip, which is a dangerous condition that should be looked for when inspecting the ropes at the machine.

It is the writer's opinion that ropes should be condemned when four or five wires are cracked in one lay of each strand. The kind of service that elevators are

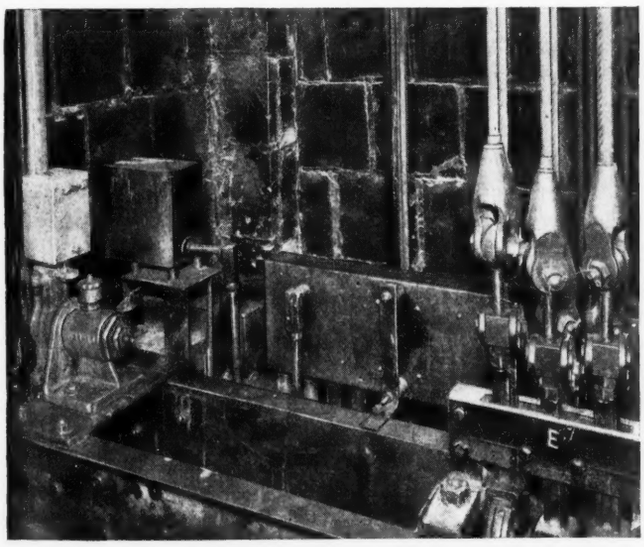


Fig. 7—Car crosshead with an automatic equalizer installed hoisting ropes at *E*

subjected to should be taken into consideration. When the service is infrequent, ropes may be allowed to remain in operation that would be condemned if the elevator were run continuously.

Ropes on hydraulic elevators should receive the same inspection as the ropes on electric elevators. On hydraulic elevators it is often necessary to ride the counterweights in a blind hoistway to inspect the ropes, which is dangerous. For the safety of the inspector, the cars adjacent to the one being inspected should not be operated while the inspection is being made. The inspector should keep his hands a safe distance from all sheaves.

There are several ways to socket ropes, but turning in of the strand ends and using babbitt metal seems to be employed most. Care should be taken when turning in the strand ends, and they should be properly seized with small wire to avoid loose strands. The bend in the strands' ends should be about half the length of the thimble. Proper size thimbles should be used, large enough to receive sufficient babbitt to make a substantial fastening. Do not remove the hemp center from the rope, as this practice will allow the strands to bind on one another and cause wires to crack inside the terminal socket. The hemp center also provides the necessary lubrication for keeping out dampness, which causes the wires to rust and become brittle. Removal of the hemp center greatly reduces the strength of the rope at the sockets, because it allows the strands to be drawn together when load is applied. The hemp center, if cut too short, may be drawn up into the rope in damp weather and can never get back to its original position.

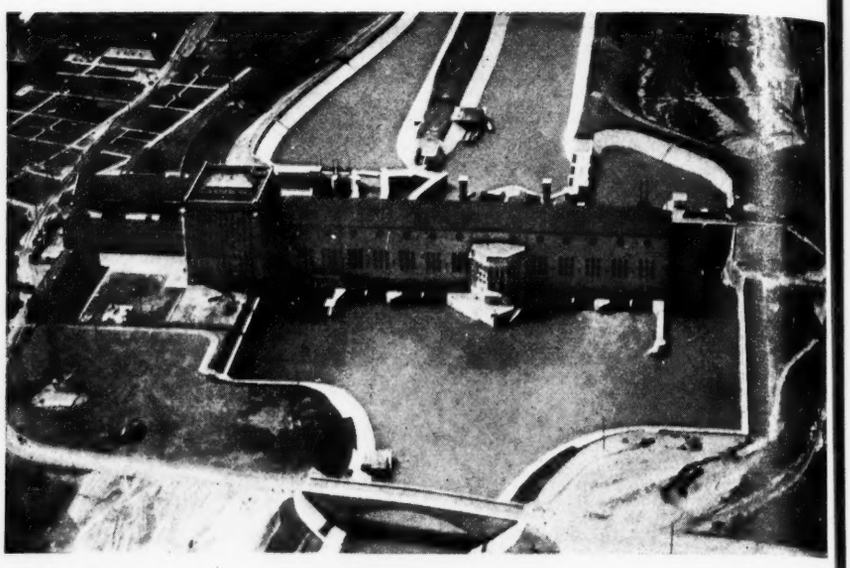
When ropes have been made ready to pull into their sockets, a hammer should never be used to drive the terminals into place, as the rope is likely to be injured. This may cause the wires to crack where least expected. Care should be taken to have the babbitt hot enough to enter all crevices between the wires and still not so hot as to injure them. A torch should never be used to heat the turned-in ends of the strands before pulling them in to the thimbles. After the babbitt has been poured it should be allowed to cool gradually.

An inspector should at all times keep in mind that he is working around moving machinery and should keep his hands and other parts of his body clear of the equipment and be ready at all times to meet emergencies. The operator may forget his instructions and, without warning, reverse the motion of the car. It is such emergencies as these that an inspector should look out for. Flash lights should always be carried and used. Do not use matches or candles. Make certain that a capable operator is assigned to the car that is being inspected and have him understand his orders explicitly. Never operate and inspect an elevator at the same time.

Garbage to Be Power Source In Ford's British Plant

ONE OF the interesting innovations that is being applied to the huge new Ford Motor Works at Dagenham, England, is the use of garbage as the source of power. This should prove effective in reducing London's garbage piles, which have given the municipal authorities a hitherto unsolvable problem.

Three high-pressure water-tube boilers will each supply the steam requirements of a 30,000-kw. generating set. The power plant is to be designed by the Woodall-Duckham Vertical Retort & Oven Construction Company, and will consist of sixteen garbage incineration cells, which will burn some 374 tons of London garbage every sixteen hours. As a source of fuel this garbage should prove almost perfect, with its low cost, low transport charge, and continuous supply.



Finsing station uses water from three sources and operates under three different heads

Unusual Features Found in Germany's ISAR RIVER DEVELOPMENT

ON THE Isar River in Germany is an unusual water-power development consisting of four plants along a canal 33 miles long that takes water from the river below Munich. The canal has a capacity of 4,500 cu.ft. per second at a flow of 5 ft. per second, and the river flow varies from about 4,000 to 55,000 cu.ft. per second. The character of the country through which the canal runs is such as to allow using the total available head at four sites.

In the table are given the principal data on the four plants. The first plant, Finsing, through which the water flows, has an average head of 36 ft. In this plant there are two horizontal-shaft 10,800-hp. units, each driven by four runners on the same shaft. Due to the different water levels in the canal, a storage basin and a fish pond, there are three different heads, which are more effectively used by the multiplicity of runners on the two turbines than they would be in a single runner. The

PRINCIPAL DATA ON THE FOUR PLANTS

	Average Head, Ft.	Number of Units[1]	Runners on One Shaft[2]	Capacity, Hp.	R.p.m.	Number of Generators	Output, Kw.	Volts	Phases	Cycles
Finsing.....	36	2-H	4	10,800	150 125	2	7,160	6,000	3	50
Aufkirchen....	86.7	4-V	1	12,700	166⅔	2	9,500	6,000	3	50
						2	2,500	6,000	1	16⅔
Eitting.....	83	4-V.	1	12,700	166⅔	2	9,500	6,000	3	50
						2	9,500	6,000	1	16⅔
Pfrombach....	69.3	1-H	8	32,000	250	1	13,700	6,000	3	50
						1	16,000	6,000	1	16⅔
						1	13,700	6,000	3	50

[1]H is horizontal shaft and V is vertical shaft.
[2]All waterwheel runners are of the Francis type.

speed is lower for the unit that obtains its water from the storage reservoir and operates usually under a lower head than the other machine, but the runners are alike.

At the next two plants, Aufkirchen and Eitting, four vertical-shaft 12,700-hp. units are used. In these plants the heads are 86.7 and 83 ft., respectively. These units require less space than the horizontal-shaft type and the draft tubes can be designed to give better efficiency. To reduce the cost of the machines, the same size was used in both plants even if the heads were slightly different.

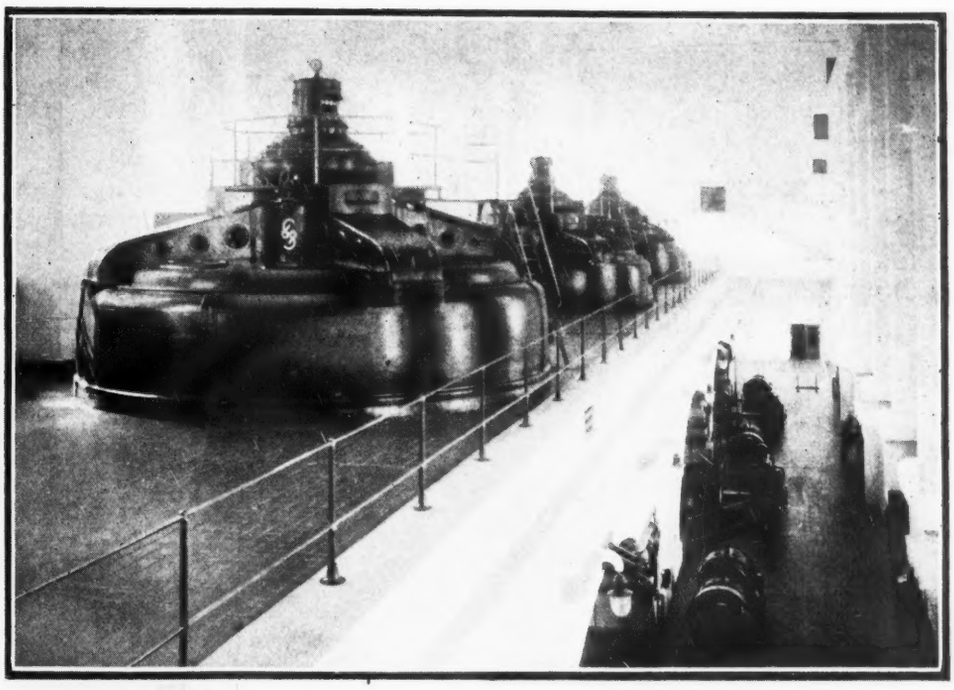
At the last plant, Pfrombach, on the canal, the head is 69.3 ft. and a single 32,000-hp. horizontal-shaft unit is used. This machine consists of eight runners coupled together. At one end of the waterwheel unit is connected a 13,700-kw., 3-phase, 50-cycle synchronous generator. At the other end of the waterwheel's shaft is a 16,000 kw., single-phase, 16⅔-cycle synchronous generator, a 17,500-kva., 3-phase, 50-cycle asynchronous generator and a regulator unit. Each runner and electric machine has its own individual shaft, which is connected to the adjacent section by a removable coupling. This permits the distribution of the water power between the 3-phase and single-phase loads according to the demands of the respective systems. The asynchronous machine on the shaft forms a flexible coupling between the 3-phase and the single-phase systems. Usually the machine is operated as two units by opening a coupling between two of the runners. The number of turbines in operation on each unit depends upon the loading on the single-phase and 3-phase systems and the water available.

In the draft tube of each runner is an air valve which is automatically opened by the governor at overspeed and helps to prevent a dangerous runaway speed.

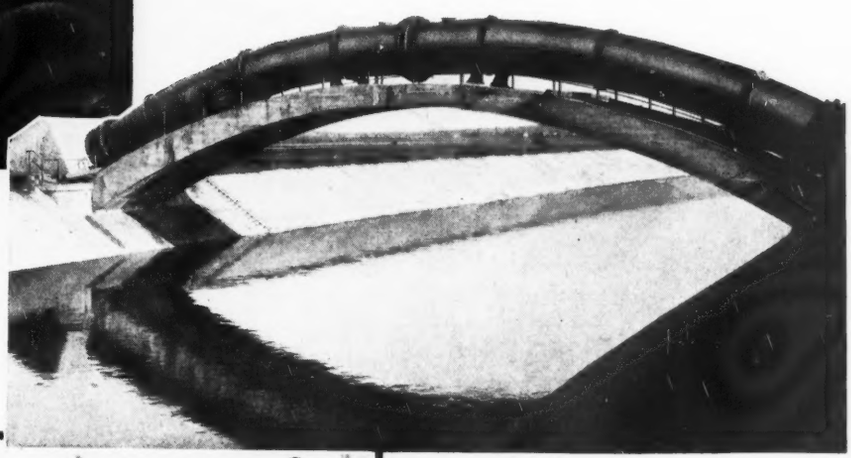
Propeller-type turbines with adjustable runner blades were considered for the development. It was found that this type of wheel was used on heads up to about 65 ft. only. Consideration of the size of the units involved, character of the loads as to size phases and frequency, the arrangement of the several plants in series on the same canal, and the efficiency of individual plants and of the system led to the conclusion that the Francis-type turbines were preferable. The load has the unusual characteristic of involving both a 3-phase, 50-cycle system and a single-phase 16⅔-cycle system, the latter for railway service. Of an average total output of 54,450 kw., from 8,000 to 22,000 kw. is used for railway load.

The information in this article was supplied by Karl A. Mayr, special engineer, Siemens-Schuckertwerke, A. G., New York City.

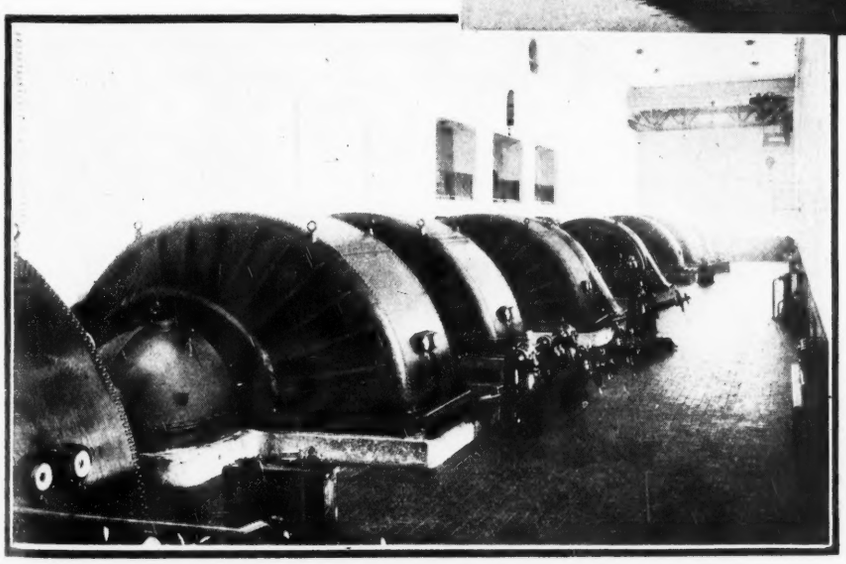
Right — Eitting plant has four 12,700-hp. vertical Francis units and the head is 83 feet



Left—A horizontal shaft unit having 8 Francis-type runners is installed in the Pfrombach plant. At one end of the unit is a 13,700-kw., 3-phase generator and at the other end a 13,700-kw., 3-phase and a 16,000-kw., single-phase generator



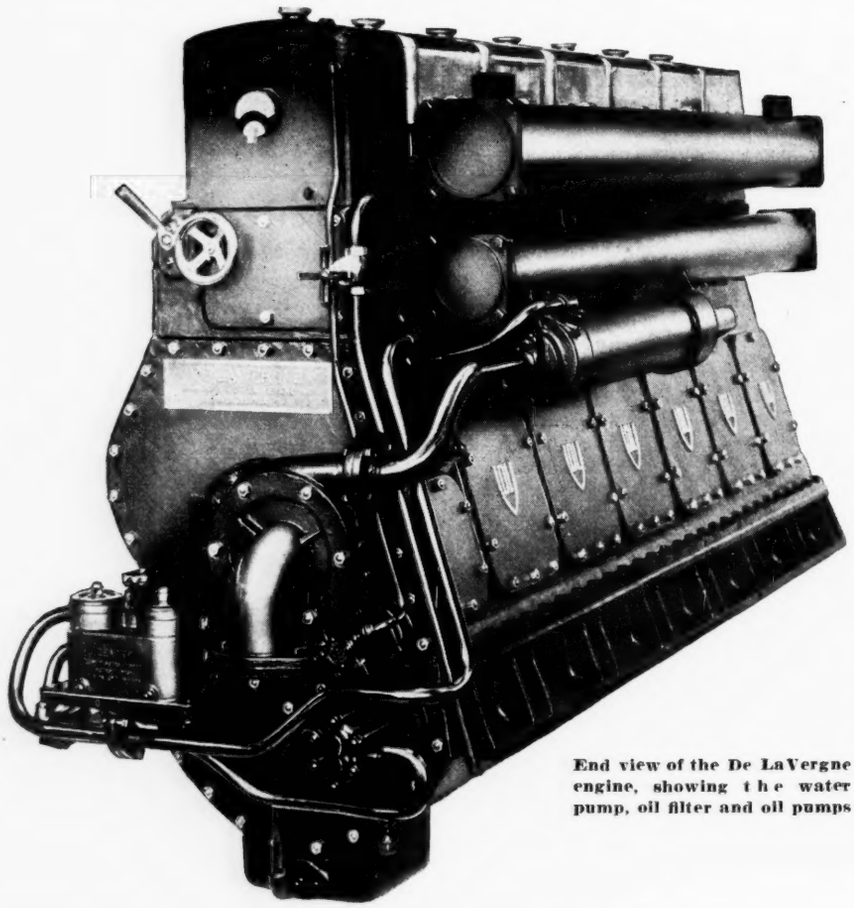
Right—Pipe line carried over the power canal on a reinforced concrete arch



Left—In the Finsing station there are two 10,800-hp. horizontal-shaft Francis units. Each unit has four runners and operates under an average head of 36 feet

High-Speed Diesel Built by De LaVergne

THOSE in close touch with machine developments have for some time sensed the trend toward high reciprocating speeds in engines, both oil and steam. The latest arrival in the high-speed diesel class is a 750-r.p.m. unit built by I. P. Morris & De LaVergne, Inc., Philadelphia, Pa., which was exhibited at the National Power Show early in December.



End view of the De LaVergne engine, showing the water pump, oil filter and oil pumps

The general specifications of the unit are as follows:

Cycle	Four-stroke
Injection system	Bosch
Cylinders	6
Bore, in.	9
Stroke, in.	11
Piston displacement, cu.in.	4,180
Horsepower (normal maximum)	300
Speed (normal)	750
Piston speed, ft. per min.	1,375
Normal m.e.p. at full load, lb.	75.5
Distance between center line of cylinders, in.	14.5
Weight, net, without flywheel, lb.	10,000
Weight of light flywheel, lb.	2,000
Weight per b.hp. without flywheels, lb.	35
Weight per cu.in. piston displacement, lb.	2.51

In the design of this unit the manufacturer has taken cognizance of the fact that a high-speed engine cannot result from the mere speeding up of a slower speed unit. Consequently the bedplate and frame are of electric-furnace iron, of such liberal dimensions and strength that deformation cannot occur even if combustion pressure should rise unduly.

The crankshaft, which even in the six-cylinder unit is counterweighted, is forged from a single billet. Supporting bearings rest in the cross members of the bedplate and are provided with circular steel shells, babbitt-lined. While the frame has been made as narrow as possible, ample room is available to permit the removal or adjustment of the bearings.

As will be seen from the illustration, the frame is carried up to form the cooling water jacket. The cylinder portion of the frame is cast with cross partitions that act as the passage to convey the air from the intake manifold to the cylinder admission valves. Cast-iron liners are pressed into the frame to form the cylinders. As an engineer examining the engine exhibited at the power show could see, the valve and cylinder head arrangements are unusual.

Instead of the separate combustion chamber heretofore employed on all De LaVergne engines, this high-speed unit makes use of direct injection into the working cylinder, the force pump and injection valve being of Bosch design.

Air enters through a longitudinal manifold and passes through the passages already mentioned and then turns upward to enter the intake passage in each cylinder head. Two admission valves are used, actuated by a pronged rocker arm and a push rod from the camshaft placed along the lower end of the cylinders. These two valves are not set symmetrically around the central fuel valve, but the irregular placing is claimed to give a tangential direction to the air entering the cylinder. The two exhaust valves are likewise driven by a single-forked rocker arm, but are placed symmetrically in the head.

Since the engine is intended for speeds ranging from 400 to 750, the piston material is of cast iron for slow speeds and of aluminum alloy for the higher ranges. The camshaft carries separate cams; the exhaust- and admission-valve cams are keyed to the shaft, with the fuel pump cam mounted on a bushing which is bolted to the other cams. A silent chain drives the camshaft, while a second chain drives the centrifugal water pump, fuel oil transfer pump and the lubricating-oil pumps.

Each cylinder has its individual fuel pump placed in a recess in the frame. This permits each oil-feed line to be of the same length, thereby better balancing the injection timing. A second commercial advantage is that in event of trouble the single pump can be replaced with greater ease than possible with a grouped arrangement of plungers. Each pump is provided with a hand lever device for priming.

Pains have been taken to avoid mixing of lubricating and fuel oil. The lubricating oil fed to the valve rockers from the pressure oiling system flows into a trough machined into the cylinder head and thence drips down along the valve push rods into the crankcase. Drips from the fuel pump are caught in a groove in the pump base and drained back into the engine service tank.

Fuel oil is delivered by a gear pump through twin

filters to the engine service tank. This pump is driven by the same chain that drives the two lubricating oil pumps. One pump lifts the oil from the crankcase to a small storage reservoir on the engine. The second pump forces the oil through a filter and cooler into the lubrication pipe lines.

In addition to these pumps, the chain drives the centrifugal cooling-water pump. All the pump discharges pass through the oil cooler, the cylinder jackets and the exhaust manifold in series. One criticism which might be voiced by operators is that the pump is too close to the engine frame to permit packing of the shaft gland. This will undoubtedly be remedied in later units.

Each cylinder is provided with a pressure relief valve and indicator cock placed in a block and bolted to the head. The present relief valve is too easily adjusted to insure correct lifting, and it is questionable if an indicator cock should be placed on high-speed engines. Certainly diagrams obtained at 750 r.p.m. by any one other than a trained engineer are by no means a portrayal of events in the cylinder. This attachment, so it is stated, will be eliminated in future units.

A fuel consumption of 0.4 lb. per brake horsepower-hour has been obtained with a compression ratio of 13 to 1, giving a compression pressure of 420 lb. and a maximum combustion pressure of 700 pounds.

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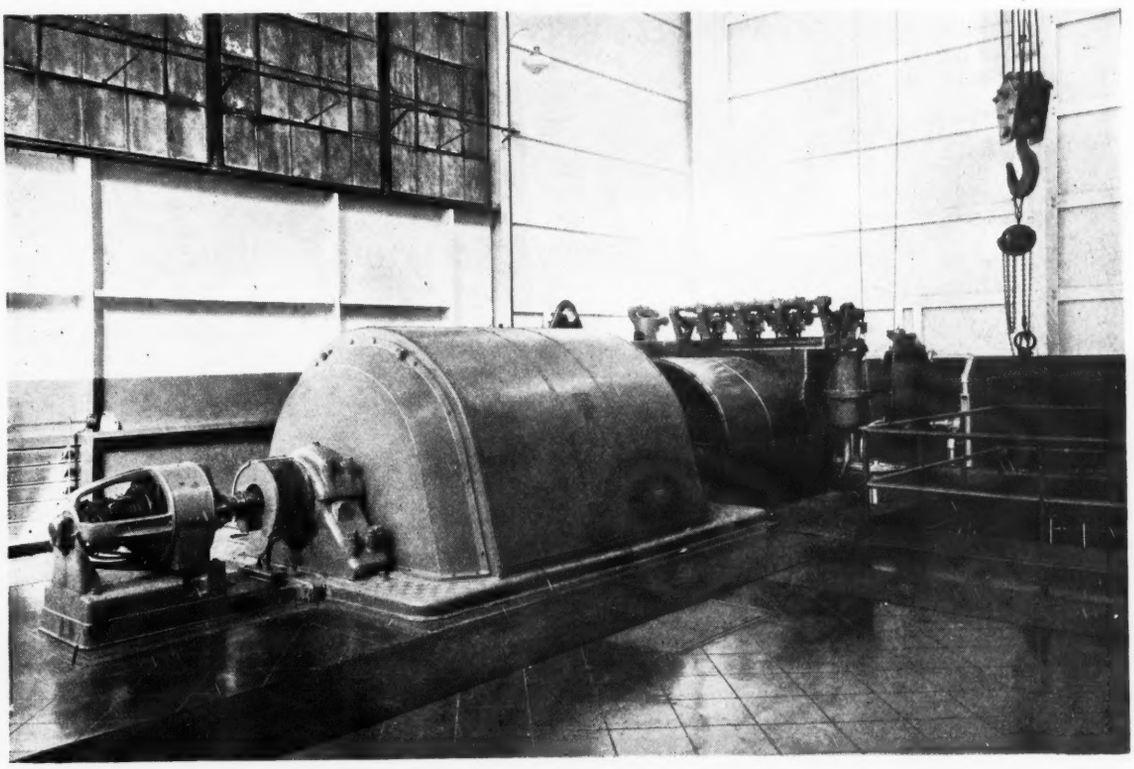
Process Steam Furnishes Economical Byproduct Power

By F. A. ROEHRIG

WHETHER to continue purchasing power or to generate part of it as a byproduct from process steam was the problem that confronted engineers of the Firestone Tire & Rubber Company when the capacity of the Los Angeles plant was recently increased by 300 per cent. All power for the original plant, which had a demand of about 6,000 kw., was purchased from the Southern California Edison Company, and process steam was supplied directly at 225 lb. from two 10,000-sq.ft. Stirling boilers. Both power and steam requirements for the new plant would be practically double that of the old.

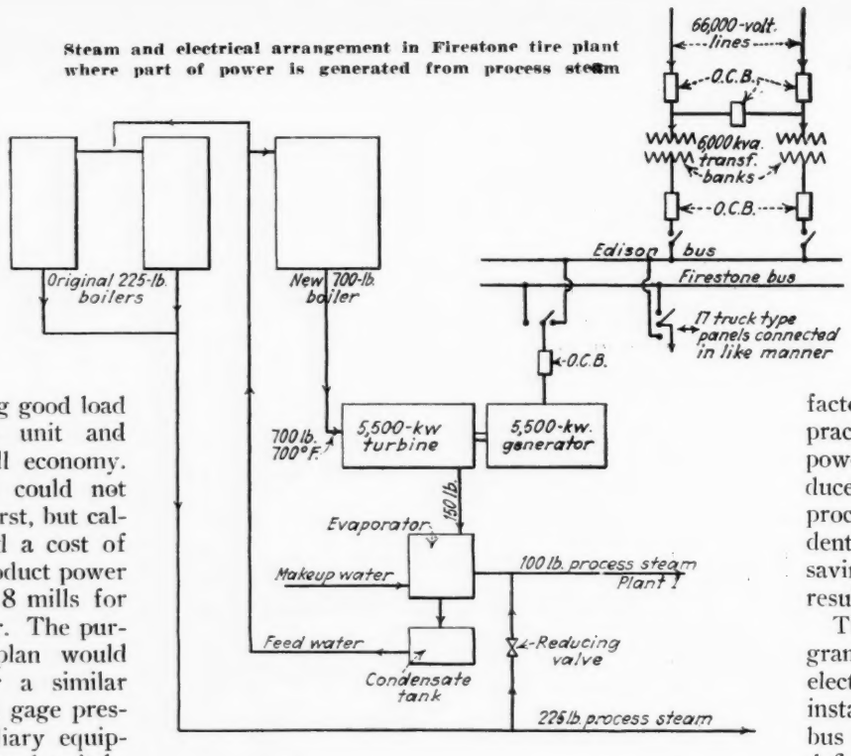
Additional demand for steam was such that greater boiler capacity would be required regardless of the plan adopted for supplying electric power. It developed that any plan called for a considerable investment, no matter whether all power was purchased or purchased power was combined with privately generated power, the latter plan calling for the greater investment. This plan proposed the installation of an 18,000-sq.ft. boiler to deliver steam at 700 lb. pressure and 700 deg. F. to a 5,500-kw. high-pressure turbine exhausting steam at 150 lb. This steam after passing through four high-pressure evaporators would produce 200,000 lb. of steam per hour at a pressure of 100 lb. for process.

The turbine would then produce byproduct power varying in amount with steam requirements. This plan, although involving additional investment, had the advan-



View of 5,500-kw. high-pressure turbine

Steam and electrical arrangement in Firestone tire plant where part of power is generated from process steam



tage of providing good load factor for the unit and excellent over-all economy. Minimum costs could not be expected at first, but calculations showed a cost of 2 mills for byproduct power as compared to 8 mills for purchased power. The purchased power plan would have called for a similar boiler of 225 lb. gage pressure, with auxiliary equipment and additional switching and distribution apparatus to meet the new power demands.

Careful consideration of all facts finally led to adoption of the combined purchased and privately generated power plan. Using the turbine to produce byproduct power, the purchased power will be reduced by the amount privately generated. Purchased power under the new plan will be approximately the same as formerly, but the rate will be slightly higher because of poorer load factor. However, since practically all additional power required will be produced as a byproduct of process steam, it was evident that a considerable saving in power costs would result.

The accompanying diagram shows the steam and electrical layout of the new installation. The double bus was provided so that a definite load could be segregated and carried independently on the 5,500-kw. generator in case of purchased power failure. Normally the two systems are operated in parallel, with the generator load varying in accordance with process-steam demands. No difficulty is expected over burdening either power source with reactive kilovolt-amperes, since the power factor of the plant load as a whole is kept practically at unity by the large number of synchronous motors installed.

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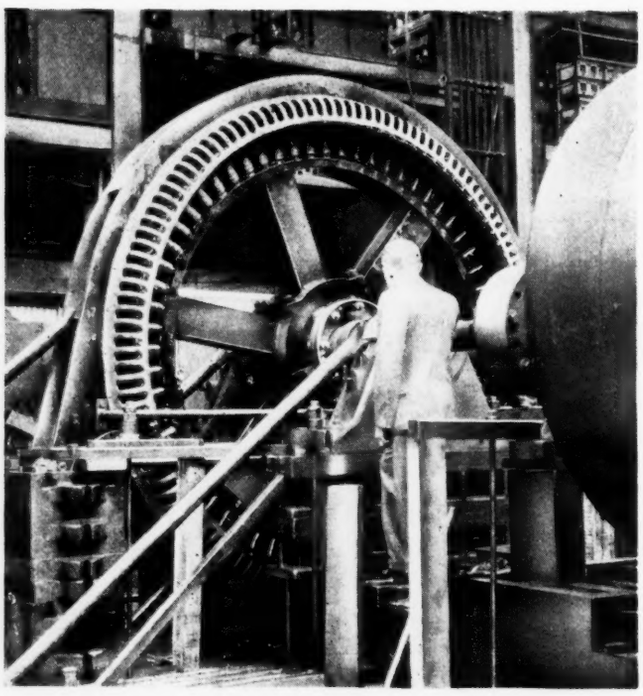


Synchronous Motor Built in Record Time

This 400-hp. synchronous motor was designed and built in the record time of 48 days by the Westinghouse Electric & Manufacturing Company. It is one of the two similar motors to drive ten- and twelve-inch merchant mills. One motor has a speed of 112½ and the other 106 revolutions per minute

...RIGHT OUT OF THE PLANT...

Improper Packing Causes Sparking on Generator Shaft

SOME TIME AGO I was called to a power plant to determine what caused sparks on the generator end of a 1,500-kva., 440-volt, 3,600-r.p.m. turbine-generator unit. The engineer was certain that the trouble was a ground or a loose connection on the rotor.

I watched the meters and could not detect anything in the way of an electrical disturbance, but had the machine shut down and tested for grounds. The machine tested clear of grounds. After going as far as possible without doing any dismantling, I noticed a dark blue color on the shaft and saw that the casing was rubbing. Upon removing the casing, I found that a weatherproof wire had been flattened and placed between the casing and the frame. The wire had served its purpose until it had become partly charred by the heat. It was replaced with the proper packing and no further trouble was experienced.

RALPH E. MACKAY.

Butte, Mont.

Getting Better Results From the Heating System

THE FOLLOWING pointer on heating plant practice can be applied in many plants where appropriations are hard to obtain. A plant I have in mind heated both its own buildings and neighboring buildings with both direct and indirect heating and both vacuum and gravity-return systems. Owing to faulty radiator traps in the customers' buildings the returns came back so hot that excessive use of cold water spray was required to the vacuum pump and steam escaped in a steady stream from the receiver vents.

To reduce the loss of steam through the vents the temperature of the water in the receiver had to be reduced without the addition of cold raw water, although much raw water had in the past been used to cool the water to secure proper operation of the feed pump. The hot-water heater for building service had a 2-in. exhaust-steam inlet and the same size of outlet as far as the trap. Live steam being always needed in addition to the exhaust, we decided to pipe the 15-lb. condensate from the indirect coils and another hot return line to the hot-water heating coil. This cooled the condensate, eliminated the raw cooling water and reduced the vent loss to that just necessary for proper air removal. No further trouble was experienced with steam-binding of the feed pump.

Another source of trouble had been the peak load thrown on the boilers when the indirect coils were put suddenly into service, which was about two to three hours a day in cold weather. We figured that if the coils were supplied with warmer air the steam consumption would be greatly reduced. But the cost of ducts for recirculating the air from the rooms served by these coils was beyond what we could spend. We finally cut a small opening through the brick wall connecting the discharge side of the fan with the inlet side and throttled the main cold air inlet sufficiently to give an air temperature of about 90 deg. instead of 20 deg. as had been usually the case. This increase in inlet air temperature gave an increased outlet temperature, but only two-thirds the quantity went to the room that was being heated. Operation of the fan for slightly longer periods was, of course, required; but as the fuel bill dropped along with the boiler peak load the results were satisfactory.

We moved the valves on several small return lines back as close to the bottom of the return riser as possible and kept them throttled down somewhat after the first two hours of heating in the morning. This procedure reduced the temperature at the vacuum pump section considerably.

A. F. SHEEHAN.

Springfield, Mass.

The Cold-Water Test on Boilers

WE HAVE HAD some interesting articles and expressions of view recently in *Power* on the value of the cold-water test as applied to boilers and I should like to mention a few cases that have come under my notice.

That the hydrostatic test on boilers has its virtues may be taken for granted, the point which can be disputed being to what extent this test should be applied, also the manner in which the test is applied.

A short time ago a return-tubular boiler, triple-riveted lap, and about twelve years old, was tested. At around 65 lb. hydrostatic test the longitudinal seam ruptured. Investigation showed that the boiler plate had been cracked for some time, but, of course, could not be seen owing to the style of joint. Two days previously 125 lb. steam had been carried on the boiler. An ordinary test pump as carried by an inspector was used.

About two years ago, while testing a water-tube boiler, a slight leakage was observed where the crossbox is riveted to the drum. The crossbox was removed. A number of the rivet holes had cracks peculiar to "caustic embrittlement." The rivet heads flew off, but it took heavier blows than are usually applied to test rivets. This boiler operated at 200 lb. pressure. About six

months later a similar boiler in the same plant showed a leak while being tested, near the top of the brickwork at the front end of, and between, the two drums. Steam leakage was never observed. This boiler showed rivet holes with fine hairline cracks as in the other boiler. Both of these boilers had been treated with caustic soda, probably to excess.

The hydrostatic test revealed these defects. A third boiler in this plant that had been subjected to the same treatment and had been in service somewhat longer was found to be in good condition. Rivets were taken out at different places, but in all cases were found good, and no defects were discovered in the plate.

Another instance where the hydrostatic test came in useful was during the testing of a vertical boiler in a logging camp. At 220 lb. test (the boiler was good for 190 lb. working pressure) leakage showed up at points close to, and parallel with, the longitudinal seam. These cracks would undoubtedly have got worse until the boiler finally gave way. This boiler was less than eight years old.

I should appreciate it if any reader could supply a formula or any data for finding the width of the waterleg in a firebox type of boiler for a given height of waterleg. My reason for asking is because my attention was drawn to a design in which the waterleg was much longer than any I had ever seen before, but there was no increase in width.

T. J. BIGELOW.

Vancouver, B. C.

Hines Plant Now Supplying Power to Utility

YOUR editorial on page 785 of the Nov. 18 number of *Power* comments upon the fact that a certain plant for furnishing power to a lumber mill might have been more advantageously used if it had been interconnected with the public utility system serving that section. You had in mind the station of the Edward Hines Western Pine Company at Burns, Ore., described in *Power* of Nov. 11.

We have always been strong advocates of the highest possible use-factor for power equipment, and believe that study given to this phase of the economical generation and use of power has most beneficial results toward lowering total costs. Our preliminary analysis and final choice of equipment, therefore, included this possibility, and all arrangements were made to deliver electric power to the public service company.

Negotiations were still pending between the Hines interests and the utility for the exchange of power when the article in question was written, so it was not considered advisable at that time to mention such interchange. Arrangements have now been completed whereby the mill is supplying power to the utility.

The utility station at Burns is completely isolated from other generating plants on the system. The distance to other communities is so great that the holding company has probably found it uneconomical to connect the station here to any other generating station by transmission line.

The utility demand is not great, so that even since the mill has taken over the entire load the use of the refuse burner is necessary. If at some future time this refuse can be used for a wood byproduct the burner will be discontinued.

C. A. SCRIBNER.

Chicago, Ill.

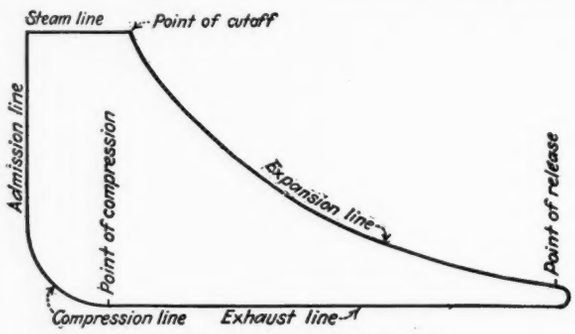
Maintaining Original Economy of Reciprocating Engines

THE ARTICLE in the maintenance number of *Power* treating on the care of reciprocating steam engines was both interesting and instructive, especially the remarks about corliss valves; but it may be of interest to go deeper.

The standard corliss valve generally used today is completely unbalanced and was developed to its present form by the elimination of forms that did not work out well. Many attempts were made to introduce engines with valves in semi- or balanced form, in combination with flywheel governors but the valves leaked badly, and although the valve motion or connections were made light, the governor could not govern well when the engine carried any considerable load.

I am reminded of a remark made by a prominent builder of a well-known corliss engine some years ago that "there were no problems at the cylinder end of his engine if he only had a flywheel governor to operate the steam valves directly, and that a 'dwell' in the motion of such positive-driven valves was all there was to it." But this was not the case, as this manufacturer freely admitted some months later. So perhaps I may be pardoned for the following explanations:

The pressure of 13,500 lb. in the example quoted in the article may be assumed as correct, but it is an error to assume that this pressure is the same all the time, even though the throttle pressure is constant. The fact is that the pressure varies underneath the valve throughout the stroke, and it should be remembered that the valve comes to a complete rest and so remains throughout most of the stroke after it is released. A short study of the typical corliss diagram shown will help to make plain just what takes place in the cycle of one revolution. While the admission valve is at rest the pressure underneath it varies from throttle pressure to exhaust pressure. The fortunate fact is that the detaching valve gear has



Typical corliss engine diagram

comparatively light work as it starts to pick up and open the valve, because the compression has advanced enough to leave the valve practically balanced. On admission, it is virtually balanced and remains so until the point of cutoff. The valve comes to rest following cutoff after covering its lap, but still moves easily because the expansion has not appreciably advanced. After that, the valve, as before stated, remains at rest while becoming more and more out of balance, very much so after the exhaust valve opens.

If the corliss detaching gear had been required to move an unbalanced valve, the invention would have died early, instead of growing, as it did, into great popularity.

It is easy to see that the durability and fine service that these valves have given is because they move when the wear from rubbing is least and the steam valves stand still about three-fourths of the time, consequently, with no wear at all.

I have made no mention of the exhaust valves, because the diagram will again show that they open and close under light pressures. A positive drive with a dwell works out nicely for these valves.

While on the subject, I might add that it is a popular idea that the drop cutoff movement is about instantaneous. The fact is the piston will travel a considerable distance while the valve is closing. Connect up your indicator so as to register this motion and see how slow the movement really is.

We may believe from the foregoing that George H. Corliss designed much better than he realized at the time, and many believe that he did not consider the important fact that the steam valves, at the time that it was necessary to move them, were in practically a balanced condition.

A further study of the typical diagram will show why the positively driven exhaust valves work well with the dwell given by use of the rocker plate operated by the eccentric.

A well-designed valve will become tighter with use. The steam consumption will be much better in a year or two of normal use. I have observed the wear, after many years' service, of valves practically tight that had worn from $\frac{1}{8}$ to $\frac{1}{4}$ in. or less in diameter. It is remarkable how well these valves will seal after they may have become cut from neglect.

It may interest many to learn that the first corliss valves were flat slides. LANCELOT COPLESTON.

Coxsackie, N. Y.

Water-Wall Experience at Interborough Station

THE INFORMATION in the article by William Welch, Jr., on "Water-Wall Experience at Interborough Station" in the Sept. 23 number is replete with numerous facts, which should provoke constructive speculation concerning water-wall and boiler design.

In the original design the side walls, as explained by Mr. Welch, were composed of fifteen tubes each. Each side wall was connected to the boiler drums by two downtake tubes and three uptake tubes. With only a static head from the drums to the side-wall tubes, two downtake tubes were supposed to convey a sufficient quantity of water to insure adequate circulation for fifteen tubes which were exposed to furnace temperatures. Furthermore, the fifteen side-wall tubes had a transverse square area more than seven times that of the downtake area, assuming all tube dimensions, 4 in. diameter, and thickness No. 10 gage.

Considering these dimensions, and the ratio of heating surface to downtake capacity, it is not surprising that contrary circulation and steam congestion existed in the side-wall tubes. All of which explains the reason for tube failures. However, the steam congestion was probably due to insufficient water supply and not uptake capacity.

The fact that the rear water wall had an equal downtake capacity, vertical tubes and less heating surface than a side wall would account for the absence of tube failures in that wall. It is doubtful if ample circulation is present in the rear wall to maintain the heating surface at maximum efficiency.

The side-wall design, as operating conditions proved, was incorrectly proportioned. And yet, taking into consideration a greater heat transfer per square foot of area in the side walls with two downtakes and three uptakes, the ratio of heating surface to uptake and downtake capacity appears to be more favorably proportioned than the boiler operated in conjunction with the side walls. The boiler is 24 tubes high and 21 tubes wide. Twenty-one downtakes supply water to 504 tubes. And these tubes, in turn, discharge into 21 uptakes—supposing the design as is commonly employed in this type of boiler. Then if steam congestion and reversed circulation obtain in the side walls it may be inferred that a similar condition prevails in many of the upper boiler tubes.

Advancing the speculation a little further: The boiler, being 21 tubes wide, has three longitudinal drums. Suppose each drum has a feed-water connection and is connected to seven downtakes and an equal number of uptakes. The downtakes from the three drums are connected to a small mud drum, which, aside from the feed-water connections, appears to be the only means of compensating for any discrepancy of water level in the three drums.

Assume each drum is receiving an equal quantity of water; that the water flows uniformly to all tubes; and, further, that the heat diffusion across the furnace is uniform. Under these conditions the water level in the three drums is probably the same.

Without a regulator on the feed line to each of the three drums, the drums probably do not receive an equal quantity of water. At times, due to conditions of the fire, one portion of the boiler may transfer considerably more heat than does some other portion. Thus, suppose the tubes directly under one drum were transferring a greater quantity of heat than the tubes under the other two drums, the water level, due to a greater volume of steam, would be higher in the drum over the tubes transferring the most heat. E. N. GINEAR.

Abilene, Texas.

Vibration in Centrifugal Pump

SOME TIME AGO a centrifugal pump was bought from a used-machinery house at a bargain and installed in a plant run by a friend of mine. After it was erected and started it was found that the pumping head was lower than expected and that the pump vibrated excessively. One day the engineer telephoned me to come down to the plant and see what he had found. Inside the casing was a large, heavy casting fin that surely had no hydraulic or mechanical reason for being there, since most pumps nowadays are made to work without diffusion vanes. We could not get into the casing with air tools, so the fin had to be chipped out by hand. Then the engineer realized why he had acquired the pump so cheaply.

After the casting fin had been chipped out and the inside sandblasted, it was painted with two coats of an enamel which dries hard and smooth and put back into service. There was no more vibration and the pump operated satisfactorily. JOHN S. CARPENTER.

Hanover, Pa.

From Among Readers' Problems

Conducted by
L. H. MORRISON

CALKING BOILER SEAMS—*Is it good practice to calk only the inside strap of a butt joint of a water-tube boiler drum?* D.M.

There is no reason why the outside strap should be calked, and the statement has been made by an authority on the subject that no boiler with inside calking had ever suffered from caustic embrittlement at the seam if the outside seam was uncalked. The explanation is that no concentration can occur between the shell and inside cover, as any liquid entering will leak outside.

REACTIONS AT THE CROSSHEAD—*If an engine is running under, where does the thrust of the crosshead come—on the top or bottom guide?* B.S.

The usual answer given to this question is that when an engine runs over, the side thrust, or guide reaction, is always downward; and upward if the machine runs under. In fact, however, these statements are not universal in application. The forces acting on the crosshead are made up of the pressure exerted on the piston, the force along the connecting rod, and the guide reaction.

On the forward stroke, steam pressure urges the piston onward, while the pressure in the crank end of the cylinder opposes the movement. After compression starts, the pressure in the crank end becomes greater than that in the head end, and the crank and rod pull the piston to the end of the stroke. Consequently, if another factor, that of inertia force, did not enter, one could say that when the piston reaches same point X in its stroke the pressure on the piston becomes zero, the force along the rod disappears and the crosshead has no guide reaction. When the piston goes beyond the position X the piston pressure becomes negative and the crank and rod actually pull the piston to the end of its stroke. The reaction against the guide is then downward instead of upward.

The other factor is inertia force. It requires a force to start the piston and other reciprocating parts, and a force to stop them at the stroke end; so the net result is that, at the beginning of the stroke, part of the force exerted by the steam is used to start the piston and bring it up to its maximum velocity, which occurs at almost half stroke. As the piston slows down after half stroke, this force is returned.

An inertia force line can be constructed on an indicator diagram, and the net pressure on the piston is the steam pressure plus or minus the inertia force. At some point toward the end of the stroke the negative steam pressure equals the plus inertia force, and no crosshead guide reaction exists. From this point to the end of the stroke the negative steam pressure may be greater than the positive inertia force; so that a negative force is exerted on the piston.

It is evident that the guide reaction near the end of the stroke is opposite to that existing during the early portion of the stroke; so no exact answer can be given without knowing the diagram the engine gives, the speed and the weight of the reciprocating parts.

PRESSURE AT REDUCING VALVE—*We have two boilers for heating and carry about 40 lb. pressure on them. Between the boilers and the main steam line we have a reducing valve which reduces the pressure to 20 lb. I have seen the pressure on the boilers drop as low as 5 or 10 lb., but the pressure on the reducing valve gage remained at between 12 and 15 lb. Are we getting that much pressure on the other side of the valve? I was always under the impression that when the boiler pressure dropped the pressure on the reducing valve would do the same.*

The steam after leaving the reducing valve has a travel of about 750 ft. If we had the full 20 lb. pressure what would be the pressure at the end of its travel? One boiler gage registers about 5 or 6 lb. more than the other. How will I find which one is right? L.F.

Evidently the boiler gages or the gage beyond the reducing valve reads incorrectly. The reducing valve will maintain the pressure beyond it at a constant value as long as the boiler pressure is above this pressure. This is based on the premise that the valve has an area sufficiently large to pass enough low-pressure steam to meet the demand. Actually the pressure beyond the reducing valve will begin to drop long before the boiler pressure reaches 10 lb. The fact that the gages still read 12 lb. when the boiler pressure reads 10 lb. is proof that at least one gage is not correct.

Without knowing the diameter of the 750 ft. of pipe and the steam flow, the pressure drop cannot be estimated. To check the several gages, ask the boiler inspector to bring in his test gage.

BRINE REQUIRED FOR REFRIGERATION—*How many gallons of calcium chloride brine, weighing 9.85 lb. per gallon and having a specific heat of 0.75 must be circulated per minute for 5 tons of refrigeration if the brine has a temperature of 12 deg. F. and is heated to 16 deg. F. by the heat absorbed?* A.T.B.

To perform refrigeration at the rate of 1 ton duty per hour calls for the removal of 288,000 B.t.u. in 24 hr., which is equivalent to 12,000 B.t.u. per hour, or 200 per minute. This is based on the following: The melting of 1 pound of ice absorbs 144 B.t.u.; so if one ton of ice is melted in 24 hr., $2{,}000 \times 144 = 288{,}000$ B.t.u. is absorbed.

The heat absorbed by brine is found by the formula

$H = W\ (T_2 - T_1)\ S$, when

H = Heat absorbed.

W = Weight of brine circulated per minute.

T_1 = Brine inlet temperature.

T_2 = Brine exit temperature.

S = Specific heat (B.t.u. absorbed per pound per degree rise in temperature).

Inserting the proper values,

$5 \times 200 = W\ (16 - 12)\ 0.75.$

$1{,}000 = 3W$, or $W = 333\frac{1}{3}$ lb.

As a gallon of the specified brine weighs 9.85 lb., the gallons circulated per minute is

$333\frac{1}{3} \div 9.85 = 33.84.$

MOTOR FOR ROTARY PUMP—*I have a hand-operated rotary pump, and would like to connect an electric motor to it. What size would you suggest, considering the following values: r.p.m., 1,700; diameter of gear wheels, 1.5 in.; gal. per minute, 6; suction head, 3 ft. and size of both; inlet and outlet, ½ in.; and discharge head, 2 feet.* J.E.B.

The horsepower required to lift water is

$$Hp. = \frac{W\ H}{33{,}000 \times E}$$ where

W = Weight of water lifted per minute.

H = Head in feet.

E = Pump efficiency.

$Hp.$ = Horsepower.

The weight W is the product of the gallons per minute and the weight per gallon. Substituting the values given in the question,

$$Hp. = \frac{6 \times 8.33 \times (3 + 2)}{33{,}000 \times E}$$

In this type of pump an efficiency of 40 per cent is about as much as one can expect after the pump has seen some years of service. Using this value in the equation, the horsepower becomes 0.019 hp. The nearest commercial size of motor could be used, preferably of $\frac{1}{10}$ horsepower.

PREVIOUS QUESTION
DISCUSSED BY READERS

THE QUESTION

WE ARE operating three sawmills and using three different types of sawdust and hog fuel at each one. At one plant we are manufacturing gum wood which has a high moisture content.

We have been trying to find some way or means of drying this fuel before putting it into furnaces. Do you know of any method or device or system, whose operation is not too expensive, for drying of this type of fuel? C.C.

A NUMBER of years ago I had a similar problem in drying tanbark. We used the idea of a rotary cement kiln as the basis of our drier, with the flue gas to dry the tanbark. The wet bark was fed in at one end of the drier, which revolved very slowly, probably not over 2 r.p.m., to work the bark to the other end, where it fell on the floor in front of the boilers.

Shelves were arranged on the inside of the drier, which, as the drier revolved, carried the bark up and slowly dropped it off. We experimented a great deal with the shelves to obtain the proper forward movement of the bark. I think it took about one hour for the bark to travel through.

It reduced the moisture content from 50 per cent to around 5 per cent. The drum was 6 ft. in diameter and 40 ft. long. The power to turn the drier was very small. We used a large fan to force the flue gas through, more because it was convenient to force all the gas through rather than to see how economically we could run the drier. We dried about 12 cords of tan bark in about eight hours, which was limited by the supply and not by the drier capacity. Our initial cost was low, as the equipment was built of odds and ends by the plant crew.

THOMAS F. WALSH.
Watertown, Mass.

—❖—

IT SEEMS quite possible to take advantage of the flue gases from the boiler for drying of gum wood. An air heater would have to be installed, and the wood conveyed through, or placed in the path of, the hot air. A fan would be necessary for conveying this heated air, and an induced draft fan would probably be required for carrying away the flue gases, unless the stack offers sufficient pull to overcome the total draft loss. GEORGE W. DAHM.
Astoria, L. I.

THE PROBLEM reads as though it were nearly solved. Presumably, after hogging, the fuel is fed to a blower which conveys it to a cyclone collector, from which it is dropped into storage preparatory to introduction to the furnaces.

This being the case, drying can be accomplished by conveying the material from the grinder to storage in a current of hot air, the temperature of which may run between 150 and 400 deg. F. Flue gases are especially adapted for this type of drying, as the low oxygen content precludes the possibility of ignition of shavings at the temperature involved.

If the conveying methods are such as outlined, no investment will be required for drying equipment. Power required by the blower will not be chargeable to the drier, since it is already necessary as a means of transporting the hogged fuel. There remains only the cost of heat for drying, and this can be had for nothing by utilizing flue gases from the breeching.

In the event that other conveying methods are in use, the equipment required for a combination drier and conveyor installation as outlined above would not run into a very heavy investment. E. L. MERRILL,
Barber Asphalt Company.
Maurer, N. J.

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AFTER EIGHT YEARS of experience in the production of steam with waste wood products for fuel, I do not believe that any method of drying hog fuel and sawdust with a high moisture content, outside and ahead of the furnace, can compete, in simplicity and economy, with the Dutch oven type of furnace. This must be of proper proportions, and the plan should include variable-speed feed screws for delivering the fuel to the charge holes at a continuous rate, and hollow blast grates on which to burn the fuel.

About two years ago the plant, a sawmill, where I am in charge of power, suddenly needed much more steam than previously, and we had to do something immediately to supply the increased demand. We had seven boilers with furnaces of the Dutch oven type, with flat suspended arches and with two charge holes. Wet, green fuel from the saws was brought from the sawmill by a chain that crossed the top of the boiler room, above a bin of about three carloads' capacity. Excess fuel was delivered from the end of this chain to a fuel car outside the power house. Chutes took fuel from the chain to the charge holes in each furnace.

These chutes, which had slides operated from the floor, were our first point of attack, as our steam-flow meters showed that every time one of the slides was opened and fuel fed to the boiler the flow would drop to 40 or 50 per cent of rating on that boiler. When the slide was closed the flow would gradually rise to about 125 per cent of rating, the maximum we were able to get, due to the fact that as the fuel dried and was consumed, bare spots developed along the four sides of the rocker grates and large quantities of air entered the furnace. A new charge of fuel would then again lower the temperature of the whole furnace.

We were unable to develop a slide that would feed the fuel uniformly, as any opening large enough to admit the right amount of hog fuel would admit enough sawdust, when sawdust alone came on the chain, to blanket the fires completely.

We then decided to install feed screws to take the fuel from the bottom of the bin where sawdust and hog fuel had become well mixed, and feed the fuel continuously to the furnace. This change proved so satisfactory that we were able to carry the load with one boiler off the line and also operate with one man less per shift in the fire room, besides making operating conditions much better.

Recently we started screening the sawdust from the hog fuel, as there was a demand for the excess if the sawdust was screened out. To burn this sawdust satisfactorily, we installed hollow blast grates in the furnace. Our experience convinces me that this combination will burn hog fuel and sawdust that has absorbed all the water it can hold. The air blast from these grates can be controlled by closing some of the openings, so that most of the fine fuel, such as sawdust, will be burned in suspension and the whole mass of fuel kept in a loose condition, which is necessary for rapid drying.

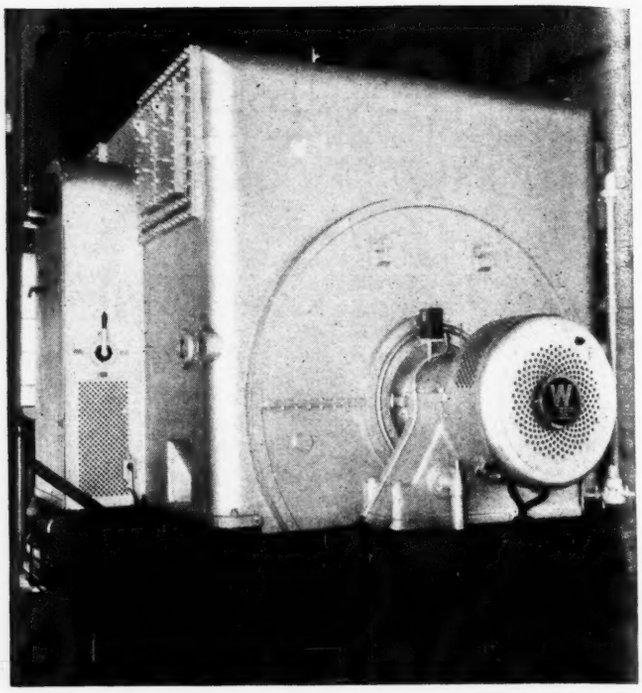
The addition of an air preheater to preheat the air to the blast grates, if the load conditions warranted, would speed up the drying and combustion of very wet fuel, and might pay for itself through the greater efficiencies obtained.

A. H. WADEWITZ.
L'Anse, Mich.

A Question for Our Readers

IS THE load due to warming up a building in the morning so much greater than the running load that the choice of heating boiler capacity if based on the latter will be too small? P.R.

Suitable answers from readers will be paid for and published in the Jan. 27, 1931, number



Turbine - generator rated at 7,500 kva., 3,600 r.p.m. designed to be cooled with hydrogen

Turbine-Generators Cooled With Hydrogen[1]

By M. D. ROSS
Designing Engineer
Westinghouse Electric & Manufacturing Company

Description of a 7,500-kva., 3,600-r.p.m. turbine-driven generator, especially constructed to be cooled by hydrogen. The design has proved to be reliable for continuous service, and preliminary studies show that hydrogen cooling is desirable for machines of 30,000 kva. rating and larger

DEVELOPMENT of large turbine-generators has progressed to where they are considerably smaller and more reliable and efficient than the corresponding machine of five years ago. The improvement is largely due to better methods of ventilation, stronger rotor steels, lower-loss armature laminations and improved methods of insulating the rotor windings. Indications are that future improvement with present construction lines will be relatively slow. In recent designs for the largest machines at any given speed there are indications that we are approaching the limits of possible ratings using the present materials and methods of construction and accepted performance characteristics. Any marked change in performance or maximum size will probably be the result of a radical change in design.

A great deal of research has recently been done on ventilation of rotating machinery by gases other than air. A survey of available gases shows that hydrogen is the most suitable for this purpose, due to its low density (about 7 per cent that of air) and high heat-transfer characteristics with forced convection. As the windage losses vary approximately in proportion to the gas density, they can be reduced to a negligible figure with hydrogen. This is an important feature in turbine-generators where the windage losses are relatively high. Hydrogen can be obtained readily in large quantities at a relatively low price. Helium, which has somewhat poorer properties as a cooling medium and is non-explosive, is not available in sufficient quantities for this purpose. Its density is about twice that of hydrogen, so that windage losses in helium would be somewhat higher.

A number of hydrogen-cooled synchronous condensers are now in service, and this type of machine is growing in popularity, as indicated by the number now on order. As the synchronous condenser does not have to be mechanically coupled with any other apparatus, it can readily be inclosed in a gas-tight casing with provision for cooling the hydrogen gas and recirculating it. The problem so far as hydrogen-cooled turbine-generators are concerned is somewhat different, as the generator shaft must be brought out through the gas-tight inclosure in order to couple it to the turbine. It is also desirable to bring the collector-ring end of the shaft outside the inclosure to permit work on the brushes while the machine is in operation. This is an important feature in turbine-generators, which are sometimes operated six months or more at a time without a shutdown.

One of the most important developments in connection with hydrogen-cooled turbine-generators has been the design of sealing glands to prevent gas leakage around the shafts where they come out of the gas-tight inclosure. Experimental work was started in 1925 to develop a seal. A survey of various methods was made and a liquid seal employing oil as the sealing medium was adopted. The seal must be fitted to a shaft somewhat larger in diameter than the generator bearing, and an oil seal was best adapted to the relatively high shaft speeds involved. Moreover, a suitable supply of oil under pressure could be obtained from the turbine lubrication system.

The sealing gland is shown in Fig. 1. The main body of the sealing gland consists of a casting surrounding the shaft, split on the horizontal center line. A part of the inner bore of the casting is machined to have a clearance around the shaft slightly greater than the clearance in the generator bearing. Oil under pressure is fed into a groove in the center of the seal and flows both ways over the shaft. The flow of oil is throttled to a minimum by fitting three small brass rings in grooves in the seal casting, which are held lightly on the shaft by coil springs. These rings are free to move radially with the shaft. The oil film between the shaft and the seal casting is sufficient to stop the flow of gas at this point, provided the oil pressure is higher than the pressure of the gas in the machine.

Oil leaving the hydrogen side of the seal is collected in a chamber in the seal casting and is returned to the main oil supply through a trap, which prevents loss of gas through the drain pipe.

[1]Abstract from a paper, "The Application of Hydrogen Cooling to Turbine Generators," presented at the Southern district meeting No. 4 of the American Institute of Electrical Engineers, Louisville, Ky., Nov. 19-22, 1930.

Due to the rings in the seal, only a small quantity of oil passes over the shaft, and the amount of hydrogen carried out in the oil is small. No special detraining tanks are required to separate the hydrogen from the oil before returning the oil to the main system.

Power losses in the seal are relatively small. To insure low ring temperatures, some oil is bypassed through a passage around the outside of the ring assembly for cooling purposes. This oil and that discharged along the shaft is returned to the system along with the oil from the generator bearings.

An experimental sealing gland was built in 1926 to determine the performance that could be expected in seals for large generators. The seal was designed to be suitable for a 7,500-kva., 3,600-r.p.m. generator. Tests showed that the loss of hydrogen in the oil was negligible, but that a certain amount of air in suspension in the oil entered the inclosure. This amounted to about 0.7 cu.ft. per day. Assuming two such seals in operation, about 70 cu.ft. of hydrogen of 99 per cent purity would be required to maintain the percentage of hydrogen in the machine at 97 per cent. The cost of this gas would be about 70c. per day. It is not likely that the cost of gas for normal operation would be more than $2 per day with the largest turbine-generators. This figure does not include the cost of carbon dioxide and hydrogen for filling the generator after a shutdown.

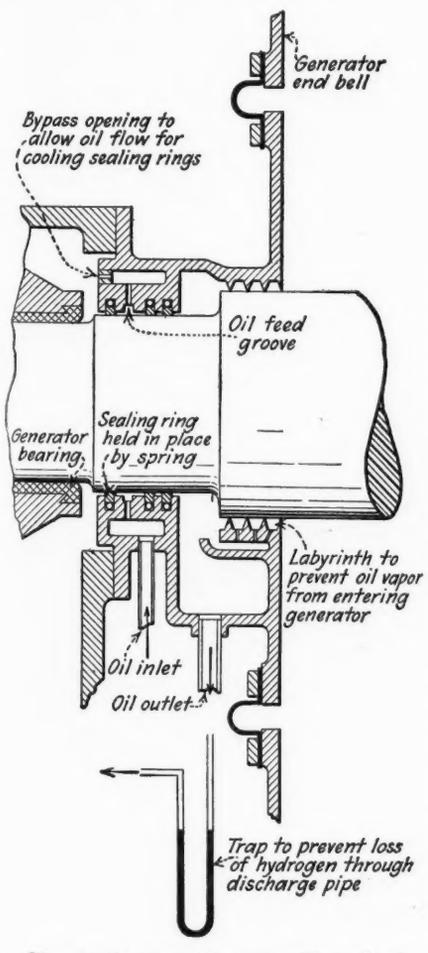

Generator end bell
Bypass opening to allow oil flow for cooling sealing rings
Oil feed groove
Generator bearing
Sealing ring held in place by spring
Labyrinth to prevent oil vapor from entering generator
Oil inlet
Oil outlet
Trap to prevent loss of hydrogen through discharge pipe

Fig. 1—Cross section of sealing gland for hydrogen-cooled generators

A 7,500-kva., 3,600-r.p.m. generator designed for hydrogen cooling and incorporating the sealing gland described was built and tested in 1928. While the rating of 7,500 kva. was smaller than the sizes of machines in which hydrogen cooling was considered to be commercially feasible, the machine was large enough to allow construction such as would be used in large generators. Tests were made with the generator running as a synchronous motor, and temperature tests were made at zero power factor. With hydrogen cooling, the generator could be rated at 9,375 kva., 80 per cent power factor, with approximately the same temperature rises in the stator and rotor as when carrying 7,500 kva. at 80 per cent power factor, with air cooling. The frame structure was built along standard lines, with certain modifications to make it gas-tight. Tests on this machine indicated that frame structures for hydrogen cooling would have to be considerably different from the air-cooled designs to obtain the minimum gas leakage.

A second 7,500-kva., 3,600-r.p.m. generator was therefore built and put on test early in 1930, and is now in operation. This machine is shown in the photograph and in section in Fig. 2. In line with standard practice on 3,600-r.p.m. generators, the generator rotor was designed to eliminate one generator bearing

The active parts of the generator are the same as in the standard air-cooled machine, and no particular effort was made to design the machine to obtain the maximum results with hydrogen cooling. Finned-tube gas coolers are built into the generator frame above the armature core. Double inclosing end bells, split horizontally at the shaft, carry the gas from the coolers to the fans mounted on the rotor. The frame is designed for the multiple-path radial system of ventilation, with a single intake chamber at the middle.

A special system for controlling the gas in the machine was developed. The aim in designing this control was to make it as simple and sturdy as possible, so that its operation would be readily understood by the average station attendant. Provision was made for repairing any part of the control mechanism without shutting down the generator.

In filling the generator with hydrogen or in removing the hydrogen it is necessary to introduce an inert gas in order to avoid an explosive mixture of air and hydrogen. Mixtures between limits of 70 per cent hydrogen and 30 per cent air and 10 per cent hydrogen and 90 per cent air (by volume) are explosive. The highest explosion pressure is developed with about 35 per cent hydrogen and 65 per cent air. Carbon dioxide was selected as the inert gas, due to its density being 50 per cent greater than that of air, so that the percentage of CO_2 gas could be determined by checking the density of the mixture.

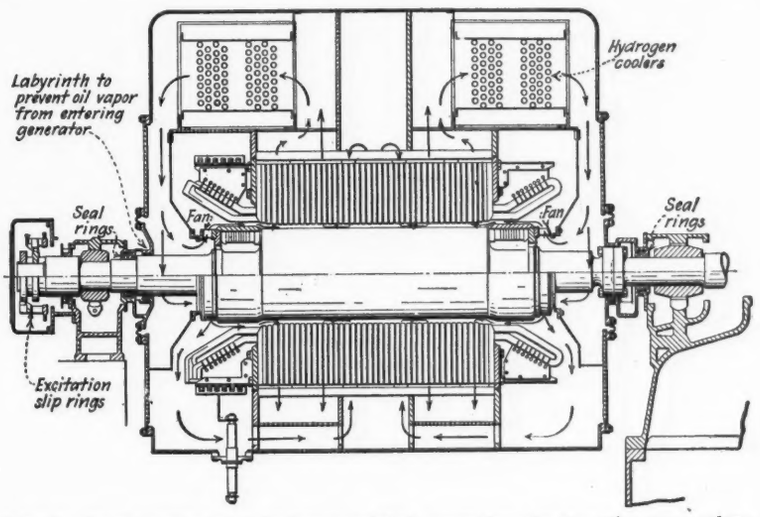


Fig. 2—Cross-section of a hydrogen-cooled generator showing the gas coolers and the direction of gas flow

Manifolds for hydrogen and CO_2 are provided at some distance from the machine, to which standard gas bottles can readily be attached. The hydrogen bottle pressure is reduced to 15 lb. per square inch before being fed to the generator. In case of failure of the reducing valve, a safety valve keeps the pressure in the line within safe limits.

The control equipment is mounted in a panel bolted to the side of the generator and is shown on the left-hand side of the generator in the photograph. This construction was adopted to simplify the piping between the control apparatus and the machine.

The machine can be filled with hydrogen or scavenged hydrogen with the generator field rotating or at standstill. With the rotor running so as to insure nearly perfect diffusion, a volume of CO_2 gas equal to about one and one-half times the gas capacity of the machine is required to remove the air. About three volumes of hydrogen are needed to fill the generator with gas of 95 per cent purity. The gas volume of the 7,500-kva. generator is approximately

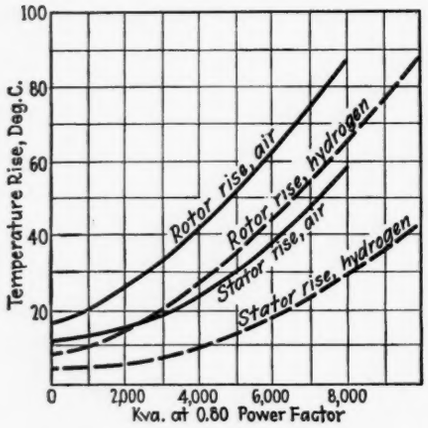


Fig. 3—Temperature rise of 7,500-kva. generator with air and hydrogen cooling

650 cu.ft. About two hour's time is required to fill the machine with hydrogen.

Relays are provided to sound a horn and light a signal light under the following conditions:

1. Machine pressure too high or too low.
2. Gas density too high, indicating contamination of the gas.
3. Gas density meter reading zero, indicating that the motor-driven fan has stopped.
4. Low pressure in the hydrogen line feeding the machine.
5. Excessive gland-seal temperature.
6. Excessive temperature of the gas in the machine in case of failure of the cooling water.

The generator has been operated over a period of 3½ months up to the time of writing this article. Operation has been satisfactory, and no troubles were encountered with the control and sealing glands. The glands, when inspected after three months' running, showed no evidences of wear, with the tool marks still visible on the sealing rings. The glands required no special attention during this period, and the valves admitting oil to them were left open at all times, so that the seals were in operation whenever the oil pump was running. When the generator was shut down with hydrogen in it, the oil pump was kept in operation, in order to maintain the seal at the shafts.

The temperature rises of the stator and rotor of the second 7,500-kva. generator with air and hydrogen cooling are given in Fig. 3. With hydrogen cooling, the machine could be rated 9,375-kva. at 80 per cent power factor. The windage loss with hydrogen was 7 kw., compared with 73 kw. with air, which means an improvement in efficiency of 1.1 per cent at 6,000-kw., 80 per cent power factor load. The cooling water required for 9,375 .kva. at 80 per cent power factor with hydrogen cooling was approximately 40 gal. per minute, compared with 80 with air cooling and 7,500 kva., 80 per cent power factor load.

The first question usually raised in connection with hydrogen cooling is: What will happen in case of an explosion? With the worst mixture of air and hydrogen, the explosion pressure will be 50 to 75 lb. per square inch, depending upon the size and shape of the gas chambers in the generator. If the frame is provided with a number of diaphrams which will blow out at relatively low pressure, the pressures developed will be lower than the values given. The operating hazard for a hydrogen-cooled generator with a control system such as that described is probably no greater than with other types of station equipment.

With the development of sealing glands and control apparatus to the point where their operation can be relied upon in continuous service, there is no apparent reason why hydrogen cooling should not be adopted for large turbine-generators. The cost of hydrogen gas should not exceed $2 per day for the largest generators, which would be negligible compared to the saving in generator losses. The labor cost for operating the generator would be no greater than for an air-cooled generator, as the turbine floor attendant can take care of the gas control equipment. While the hydrogen-cooled design would be somewhat harder to dismantle than an air-cooled design, the absence of dirt and corona effects in the machine would probably more than balance that point in estimating the cost of maintenance. With built-in gas coolers, as in hydrogen-cooled machines, considerable space under the generator would be available for removal of condenser tubes and for auxiliary apparatus which is not available with air coolers located below the generator.

Preliminary studies of large turbine-generators indicate that hydrogen cooling would be desirable in ratings of about 30,000 kw. and larger, where the additional cost of the gas-tight inclosure and the control equipment would be relatively small in comparison with the cost of the generator, and the saving in losses would justify the slight additional complication due to this method of cooling.

▼ ▼ ▼

Analysis of Flywheel Accidents During 1929

By K. RANKIN

A TOTAL of twelve lives was lost and ten people were injured in the 29 flywheel accidents recorded by the Hartford Steam Boiler Inspection & Insurance Company during 1929. Of these 29, one was due to an emery wheel bursting in a factory. Each of the other 28 were strictly power plant accidents. For this same period, 1,284 accidents occurred to boilers and pressure vessels, the toll being 89 persons killed and 254 injured. For every one killed by a boiler or pressure vessel accident during 1929 2.74 persons were injured. One person was killed or injured for every 3.75 boiler accidents.

The flywheel accidents during 1929 resulted in twelve people being killed and ten injured, a ratio of 1.2 fatalities to 1 injury. Moreover, the 29 flywheel accidents with their 22 deaths or injuries resulted in fatality to or injury of 1.32 persons to every flywheel accident. It can be seen, therefore, that the loss and injury to human life is considerably greater—actually about twice as great—as is the case with boiler accidents.

Major flywheel accidents occurred during 1929 as follows:

Type of Plant	Total Number of Accidents
Shingle manufacturers, saw rigs, portable sawmills	6
Public utility electric light and power plants	5
Paper mills	4
Municipal power plants	2
Manufacturing plants	7
Laundry	1
Pumping station	1
Farms	1
Residences	1
Total	28

The large number of accidents among lumber working plants or camps stresses the importance of closer inspection and greater precaution in the use of band and special saws. The accidents to these woodworking plants all occurred in out-of-the-way places where supervision is apparently lax. Incidentally, it is interesting to note that saw rigs and portable sawmills suffered during their accidents a loss of two dead and two injured.

Of the five accidents to turbines, four occurred in central station plants and one in the plant of a cereal manufacturer. One central station company suffered two turbine accidents, although in two different plants. The causes of these five turbine accidents were as follows:

Class of Turbine Accidents	Number of Accidents
Fan on turbine, explosion	1
Oil pump, turbine disk, explosion	1
Turbine rotor exploded	1
Turbine disk exploded	1
Turbine exploded	1
Total	5

The various classes of flywheel trouble were as follows:

	Number of Accidents
Flywheel exploded	11
Engine flywheel exploded	3
Belt wheel exploded	3
Flywheel burst	1
Engine ran away, governor failure	1
Belt wheel broke	1
Gas engine flywheel exploded	1
Pulley burst	1
Emery wheel burst	1

The Multiple-Superheater Boiler

By K. BAUMANN

On Nov. 6 Mr. Baumann made important contributions to engineering thought in a paper presented in Manchester, England, before the Northwestern Branch of the Institution of Mechanical Engineers. There he discussed the future devlopment of the steam cycle with particular reference to higher pressures and temperatures. The excerpt here presented describes a boiler unit wherein a primary superheater replaces all convection water-heating surface

INVESTIGATIONS indicate that the steam temperature for power stations is limited by the creep properties of existing materials and that steam plants for temperatures above 800 deg. F. require very careful examination from this point of view. Available creep characteristics of existing materials show a definite falling off in the strength of the materials at higher temperatures.

The adoption of high temperatures has been encouraged recently, as it has enabled the use of higher pressures without reheating the steam. If the wetness in the exhaust is to be kept below a certain maximum (say 12 per cent) to prevent excessive corrosion, then it will be possible to raise the pressure with the temperature according to Curve *A* in Fig. 1.

By raising the temperature from 800 deg. to 900 deg., for instance, the pressure could be raised from 430 lb. to 680 lb. The improvement in thermal efficiency of the plant by raising both temperature and pressure would be, roughly, 8 per cent for every 100 deg. temperature increase, whereas improvement by raising temperature only would be one-half, or 4 per cent, Fig. 2.

The use of higher temperatures, together with correspondingly higher pressures, as suggested, is seriously handicapped by the variation in the steam temperature that occurs in most boilers using convection-type superheaters with varying load. The greater the load on the boiler, the higher the superheat. This means that at periods of highest loads the conditions become most severe, which obviously should be avoided if possible.

With higher temperatures, which means higher superheats, as shown in Curve *B*, Fig. 1, this variation of total temperature becomes greater than with moderate steam conditions, because the proportion of heat to be transmitted in the superheater becomes larger and the proportion of heat required to evaporate water becomes gradually smaller.

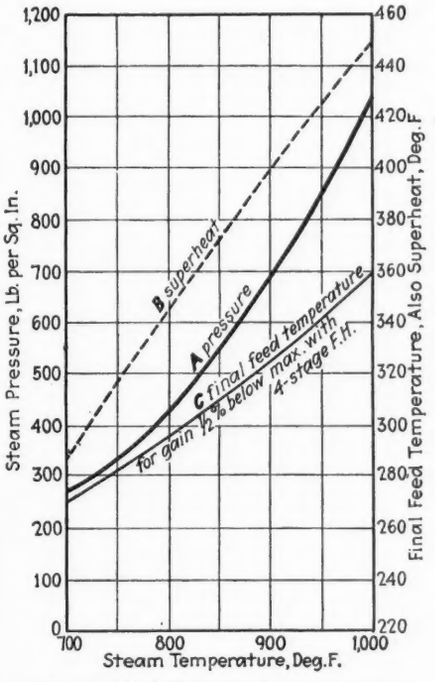


Fig. 1—Variation of steam pressure with steam temperature. Based on 29-in. vacuum, 12 per cent moisture in last stage and 85 per cent turbine efficiency

This is shown in Fig. 3 for the condition that feed water is supplied to the boiler at temperatures given in Curve *C*, Fig. 1. These are calculated on the basis of four-stage feed-water heating and for the gain due to feed heating being 0.5 per cent below the maximum theoretical gain. Temperatures calculated on this basis produce, for average conditions of load factor, cost of coal, etc., the maximum economic gain.

The ratio of heat in superheat to heat of evaporation shown in Fig. 4 is:

21 per cent at	700 deg.	and	270 lb.
28 per cent at	800 deg.	and	430 lb.
37 per cent at	900 deg.	and	680 lb.
50 per cent at	1,000 deg.	and	1,040 lb.

In view of these conditions and the rapid decrease in creep strength of all materials at higher temperatures, it becomes increasingly important to provide boiler plant in which the superheat can be automatically controlled.

It is suggested that the boiler shown diagrammatically in Fig. 5, which may be called a multiple-superheater boiler, meets these conditions and offers at the same time various other advantages. It retains those parts of the existing boiler that have proved successful and which are essential (such as water-cooled walls), but all water tubes, apart from those exposed to furnace radiation, are eliminated.

The necessary convection cooling surface for the gases is obtained by means of superheater tubes, in which the steam is superheated twice, each process being carried out in a separate superheater. Before the steam passes from the first to the second superheater it is cooled in tubes, immersed, or partly

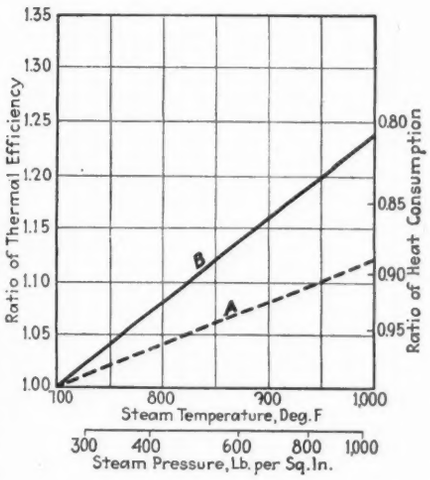


Fig. 2—Improvement in heat consumption
A—By raising temperature only
B—By raising both temperature and pressure

immersed, in the water in an evaporating drum. The water evaporated in this drum is added to the steam evaporated in the boiler proper and passed together with it to the first superheater.

The gases pass from the furnace *A*, which is surrounded by water walls *B*, to a superheater chamber *C*, arranged above the furnace but protected from the radiation of the furnace by two or more rows of tubes that form part of the circulation between the back water wall and the boiler drum *D*.

The desuperheating evaporator is shown at *E*. Steam from both drums *D* and *E* passes to the first superheater, which is shown to be arranged in counter-current with the flue gases. After being superheated it is led to the cooling tubes arranged within the evaporating drum *E*. As the pressure on the water side is slightly higher than

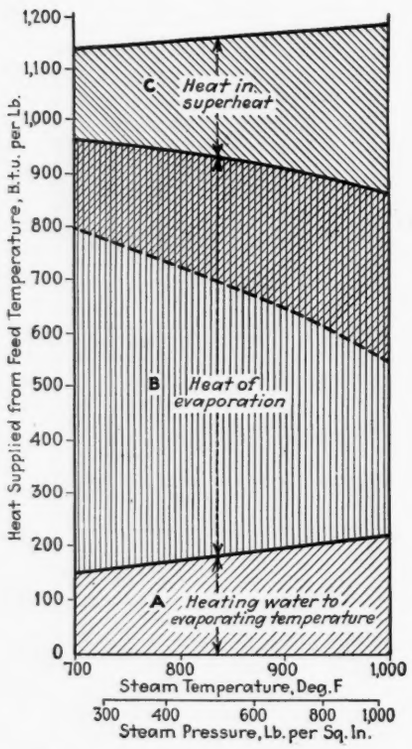


Fig. 3—Heat transmitted in a boiler

that on the steam side, the steam is cooled to a temperature higher than saturation temperature and it is then led to a second superheater, which may be arranged in parallel current with the flue gases, to keep the temperature of these tubes, which are exposed to the hotter gases, as low as possible. After being superheated to the required temperature, which is automatically controlled, as described later, the steam is supplied to the turbine.

The additional steam supplied by the desuperheating evaporator may be 20 to 40 per cent of the total steam quantity, according to the superheat and pressure used. The maximum amount of heat that may be taken up in the additional superheater is indicated by the cross-hatched area in Fig. 3. These figures are therefore well within the range of possibility and show quite clearly that the multiple superheater can be used to displace the usual convection surface of a boiler, since in practice boiler operation figures have shown that it is possible to transmit to the furnace walls amounts as high as 80 per cent of the heat of evaporation.

The evaporator tubes may be of the hairpin type, and the separate evaporating drum would be of a design similar to a high-pressure feed heater, with the exception that the steam passes through the tubes and the water surrounds the tubes.

Tubes of greatest obtainable length can be used for the construction of this boiler, thus reducing the number of expanded joints to a minimum. The full height of the boiler unit, from the bottom of the furnace to the drum, is available to maintain natural circulation, and this applies to all the heating surface of the boiler; that is, there are no mixed systems of circulation within the boiler.

The superheater tubes may be of a relatively small diameter, reducing the weight of material for a given surface. They may be bent and also made in great lengths so that the number of joints is greatly reduced. All superheater supports are arranged outside the gas passages and the superheater itself is accessible for cleaning and adjustment.

The final superheat is maintained constant by automatically controlling the active surface in the evaporator by lowering or raising its water level. This is effected by means of a relatively small throttle valve *F* arranged in the saturated steam pipe from the evaporator, the valve being controlled from a thermostat in the steam pipe after the final superheater. Thus there is no higher steam temperature obtained in any part of the plant than that intended for normal operation.

The arrangement of economizers, preferably steaming economizers and air heaters at the back of the boiler, as shown, makes for compactness and simplicity. The number of tubes discharging into the drum is far less than is usually required with existing boilers, so that the strength of the wall of the drum is not reduced to the same extent. The thickness of the wall can therefore be reduced, further lowering the cost of the drum.

All water tubes are conveniently arranged to enter

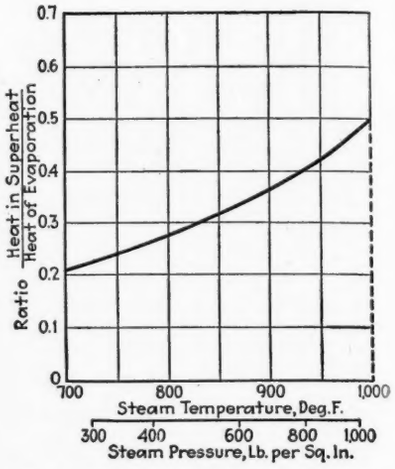


Fig. 4—Ratio of heat in superheat to heat of evaporation (based on Fig. 3)

the drums near, and mostly above, the water level, thus minimizing to a large extent, the risk of priming, while the drum is so located that it is not exposed to the hot gases.

All expanded joints between tubes and the drum and intermediate headers can be arranged external to the furnace, so that any steam leakages become visible and can be remedied as soon as they occur.

As expanded joints are not exposed to high gas temperatures, large differences in temperature between the expanded tube and the headers or the boiler drum are eliminated. Added to this, the stresses on the joints are kept to a minimum by the tubes' flexibility.

The design of existing types of boilers varies for each particular case, as the surface required in the water tubes and the position of the superheater

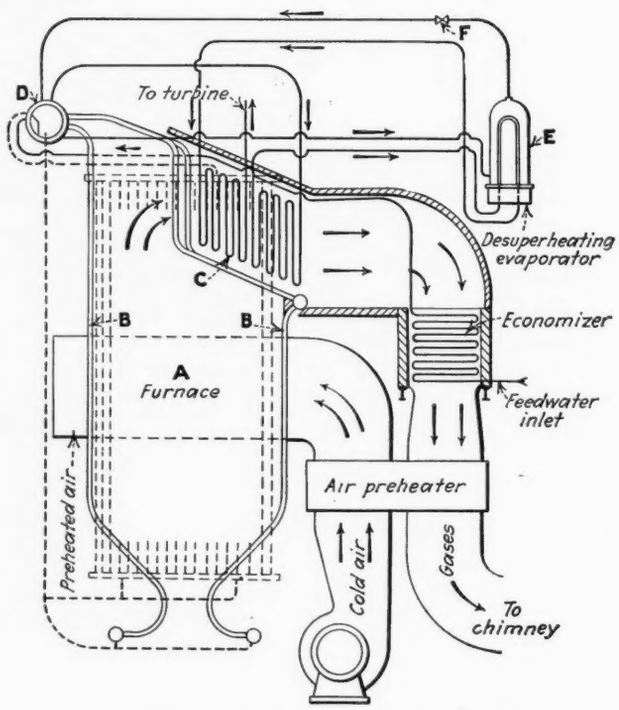


Fig. 5—Diagrammatic arrangement of multiple superheater boiler

EVAPORATING VESSELS FOR 50,000 LB. OF STEAM PER HOUR

(Steam velocity through tubes 50 ft. per sec. Tubes ¾ in. I.D., ⅞ in. O.D. Pitched 1¼x1¼ in. Maximum steam temperature, 800 deg. F.)

Steam pressure, lb. per sq.in.	600		800		1,000		1,400	
Saturation temperature, deg. F.	491		523		549		591	
Minimum temperature difference between cooled steam and evaporating water, deg. F.	30	60	30	60	30	60	30	60
Cooled steam temperature, deg. F.	521	551	553	583	579	609	621	651
Mean temperature difference between superheated steam and evaporating water, deg. F.	120	152	111	142	106	137	92	119
Over-all heat-transfer coefficient, B.t.u. per sq.ft. per deg. F. per hr.	150	150	184	184	215	215	270	270
Pressure drop through tubes, lb.	3.3	2.4	4.5	3.3	5.8	4.2	8.5	6.2
Approximate inside dimensions of evaporating drum for 50,000 lb. per hr. — Diameter	4′ 4″	4′ 7″	3′ 10″	4′ 1″	3′ 6″	3′ 9″	3′ 0″	3′ 4″
Approximate inside dimensions of evaporating drum for 50,000 lb. per hr. — Length	11′ 0″	8′ 3″	11′ 3″	8′ 3″	11′ 3″	8′ 0″	11′ 9″	8′ 0″

depend to a large extent on the quality of the fuel, the efficiency aimed at, etc. In the new boiler these conditions would not affect the design of the furnace itself or of the water wall; it would affect only the size of the superheaters and the size of the evaporating drums. These need not be determined with great accuracy, as the additional evaporation is automatically controlled. This boiler is therefore also suitable for using different types of fuel.

Advantages outlined above are obtained by the use of an additional evaporating drum. Surface required in this drum depends largely on the heat transmission between the superheated steam and the boiling water. This varies with the steam pressure and the steam velocity, as is shown by the figures given in the accompanying table. The tubes in the evaporating drum can be kept small in diameter, and tube thickness need not be great, as the difference in pressures on the two sides is small.

The extra cost involved in providing this drum is less than the saving resulting in the cost of boiler itself. As the heat transmission increases almost in direct ratio with the steam pressure, this boiler is particularly suitable for extra high pressures, but it is estimated that even for moderate pressures of, say, 400 to 600 lb. the cost of this type of boiler would be materially lower than that of the conventional type.

As the steam is heated and cooled and heated successively, and as it is still superheated after cooling, any water carried over from the boiler would have every opportunity of being evaporated before it entered the turbine. Difficulties due to scaling of superheater tubes and consequent overheating are avoided, as the first superheater, which is supplied with steam from the boiler drum, is exposed to low temperature gases only.

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Specifications Vs. Brands in the Purchase of Lubricating Oils*

BECAUSE of its importance and the widely differing practice followed in purchasing turbine lubricating oils, the American Standards Association determined the purchasing methods used by organizations buying large quantities of such oils. With three companies supplying information, three different general methods of purchasing were found.

The Philadelphia Electric Company purchases oils exclusively on a specification basis. The specification used for steam turbine lubrication follows.

The oil shall be a pure petroleum product, properly refined to make it suitable in every way for the uses hereinbefore specified; it shall be a new oil made without the admixture of any fatty oils, resins, soaps, or any other compounds not derived from crude petroleum.

The flash and fire points, open cup, shall have the following minimum values:

Flash .....315 deg. F.
Fire .....355 deg. F.
A.S.T.M. method D92-24

The maximum pour test shall be 40 deg. F.

The viscosity, in seconds, Saybolt Universal, shall be as follows:

Limits at 100 deg. F. .....135-165 sec.
Minimum at 210 deg. F. .....40 sec.

Oil shall be absolutely free from mineral acid, and the organic acidity, expressed as the amount of potassium hydroxide required to neutralize one gram of the oil, shall not exceed 0.05 milligram.

A clean copper strip shall not be discolored when submerged in a sample of the oil for three hours at 212 deg. F.

The oil shall be tested by the A.S.T.M. steam emulsion test. The time required for separation of 20 cc. of oil shall not be greater than 40 seconds.

The oxidation number (formerly known as the Sligh oxidation number) shall not be greater than 30. The oxidation number shall be determined by the method used at the Bureau of Standards in 1926 and known as the oxidation number of mineral oils, which may be obtained from the Bureau of Standards.

Commenting upon this specification, N. E. Funk, vice-president in charge of engineering of the Philadelphia Electric Company, says:

"All the tests referred to in this specification are standard tests of the American Society for Testing Materials, with the exception of the Sligh oxidation test. This test, while looked upon with favor by the society because of its reproducibility, has not been adopted as tentative or standard for testing turbine oils, since its relation to service performance has not been satisfactorily established."

The Detroit Edison Company, on the other hand, finds that specifications are not adequate for the purchase of its lubricants. The chief reason for this, according to C. H. Fellows, chemist, the Detroit Edison Company, is that all of the factors involving oil quality are not fully understood, and those that are appreciated as criteria have not lent themselves to satisfactory or easy measurement.

By experience, the power plant engineer has found that some branded oils give a certain degree of satisfactory service in steam turbines. The fact that the same degree of satisfaction is not experienced by all engineers upon the use of a specific brand of oil does not appear to alter the opinion of those who find that oil adequately meets their requirements. The result is that, in general, each engineer has his own brand of turbine oil which seems to meet his needs, and that there are really a large number of branded oils that are rendering satisfactory service. Since this company has, by experience, proved to its satisfaction that one particular brand of turbine oil adequately meets its needs, it merely checks the constancy of quality in successive shipments by such established tests as the specific gravity, viscosity, steam emulsion, and Sligh oxidation tests.

V. M. Frost of the Public Service Electric & Gas Company states that this company's turbine lubricants are purchased upon specifications furnished by the manufacturer indicating the quality that he expects to maintain in his product, which product tests show will give satisfactory service.

Manufacturers are advised that an oil for turbine lubrication with a viscosity of approximately 150 sec. Saybolt at 100 deg. F. with a high demulsibility is desired. In submitting a sample the manufacturer is requested to state his own limits of tolerance within which all samples of oil would comply, with respect to specific gravity, viscosity, flash point, fire point, maximum acidity and demulsibility.

Upon receipt of a sample, it is analyzed by the laboratory for compliance with the manufacturer's own specification as to the physical properties noted above, and then put through a further series of accelerated laboratory tests simulating service conditions to determine so far as possible the probable behavior of the oil in service.

If the results of these tests are favorable a further service test is usually made in an operating turbine to obtain further information regarding the performance of the oil.

The result of all these tests determines the oils which the department will consider for use in the various plants.

*Abstract from American Standards Association Bulletin.

A Warning to American Patent Owners

By R. H. ANDREWS
Consulting Engineer
Paris, France

Frequently, foreign patents of great potential value are rendered worthless by premature disclosure of inventions, which is sanctioned by the United States patent laws but by no other nation

THERE is a clause in United States patent law which, if considered alone, is very favorable to the inventor, and is based on a judicious sense of the practical conditions and difficulties which have a bearing on the conception and the subsequent development of an invention. But in all cases where business activities based on United States patents extends outside the limits of the country, this same clause becomes a source of danger, and, if taken advantage of in the United States, may ruin the business possibilities in nearly all the other countries in the world, because it has no counterpart in the patent law of any other nation.

The clause referred to is that which allows the inventor a period of grace of two years, from the conception of his idea to the filing of his first patent application, to pursue his research and development work, and also his commercial negotiations for the purpose of disposing of his rights. The only condition imposed upon him is that he take the proper precautions to fix the priority date, that is, the date that he claims as marking the first conception of his idea.

Now the point of capital importance in this clause, in so far as concerns future business possibilities outside of the country that may be founded upon United States patents, is that, during this period of grace, the inventor is allowed to disclose his invention in any way, as by the publication of descriptive articles or advertisements in the professional press, or the circulation of catalogs, technical bulletins or other advertising matter in business circles, for the purpose of arousing an interest in his ideas. This he can do freely, without in any way alienating his right, in the United States, to the priority date. But every American inventor should fully understand that, if he avails himself of this right to disclose his invention in the United States before he files his patent application, he kills all his chances of obtaining valid patents in the rest of the world—with the possible exception of Great Britain—for, from the date of the first public disclosure in the United States, his invention becomes public property in nearly all the other countries.

British patent law differs from that of most other countries in that public disclosure within the country alone is considered as nullifying the novelty of an invention.

Cases where large blocks of foreign patents based on one or more United States patents are null and void, through prior publication of the parent patent, are undoubtedly far more frequent than is generally realized, for such flaws usually remain hidden until the patents are challenged. However, the writer has run across two such cases, in both of which a large block of foreign patents, the filing of which had cost several thousand dollars, and upon which royalties amounting to several hundred thousand dollars had already been paid, were found to be absolutely worthless, through the publication of articles and advertisements in the American technical press, in one case only three weeks before the filing of the parent application. As a result, the patentee found himself the owner of only one patent, in the United States, instead of patents in practically all the important countries in the world.

Legal Liability

Let the reader suppose that he has purchased certain foreign rights, in compensation for which he has paid over large sums in royalties, when he suddenly discovers that the rights signed over to him were non-existent—that he had bought a "gold brick." The natural reaction is to turn back on the patentee for redress.

The attitude of the law courts toward such problems varies in different countries, and the writer does not pretend to have sufficient knowledge and experience in international patent law to state what would be the outcome of such action in the principal countries in Europe. In fact the object of this article is partly to prompt European readers who are better informed than himself to state the treatment which such problems usually receive in their country, and so complete the information placed at the disposal of American inventors.

The writer has had occasion to look into the matter in France; and, inasmuch as Belgian, Italian and Spanish patent laws are closely similar to the French, the following information may be taken as applicable to these four countries, unless contradicted by readers from the first three.

In its decision regarding the liability of the patentee in such a case, French law makes a difference depending on whether the patents were sold outright, or whether a license was granted under them.

Sale of Foreign Patents

In the first case, the purchaser has no redress, for the broad principle of *caveat emptor* (let the buyer beware), applies. This is not always the case for sales involving other objects or privileges than patent rights. In all cases in which a flaw is discovered in the object of a sale after the transfer of this object, French law considers three main cases: (1) The flaw or defect of the object is hidden; (2) the flaw or defect is not hidden, but apparent; (3) there has been misrepresentation of the quality of the object.

Now, rightly or wrongly, French jurisprudence has classed the non-validity of patents as an apparent defect, which the buyer should detect before the transfer. This decision may be arbitrary in many cases, and particularly in that of nullity due to prior publication; for it is manifestly extremely difficult for a prospective buyer to search current literature to determine whether or not the invention has been disclosed; whereas, in nearly all cases, the patentee himself is fully informed in this respect. From this point of view, the indiscriminate application of the principle of *caveat emptor* may well lead to an injustice. However, the fact remains that, if you buy a worthless patent, you have no redress.

Transfer by License

Strange as it may seem, the case of a transfer of patent rights under license is entirely different. French law considers that, in this case, the signing of a license agreement by the licensor implies the validity of his rights, even if the contract contain a clause stipulating that the licensor does not guarantee the validity of his patents. Of course, the licensee cannot himself challenge the validity of the patents under which he holds a license; but, if these patents should be proved void by the action of third parties, he has, at least theoretically, the right to claim the immediate cancellation of his contract, the reimbursement of all the royalties paid thereunder, and the payment of damages if he can show that he has suffered any from the non-validity of the patents.

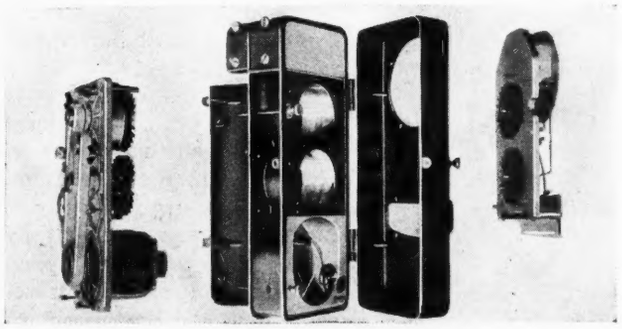
Though such drastic condemnation is rarely to be feared, it should be emphasized that, of all the motives that may serve to secure the annulment of a patent, prior publication of the parent case is by far the most serious. It inevitably casts a certain shadow on the good faith of the patentee, and court decisions in such cases are practically always favorable to the licensee, at least to the extent of the immediate cancellation of the contract. It is, therefore, heartily recommended that American inventors carefully avoid any move that can be construed as a public disclosure, until after they have filed their United States applications.

WHAT'S NEW IN PLANT EQUIPMENT

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING, TRANSMITTING AND APPLYING THE POWER SERVICES

Improved Co Indicator and Recorder

IN THE new design of Ranarex CO_2 indicator and recorder recently introduced by the Permutit Company, 440 Fourth Ave., New York City, the same principle of operation as characterized the older units has been retained, but the design has been simplified and the machine made more compact.



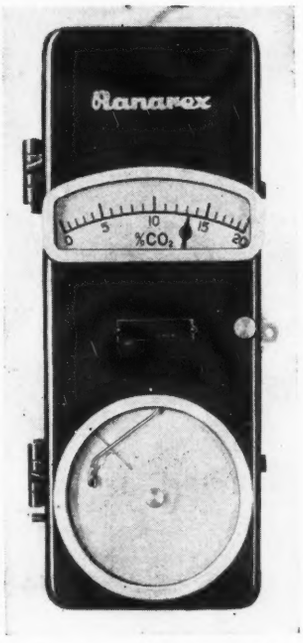
Opened for inspection. Left, plate with indicating and recording mechanism; center, dustproof aluminum casing; right, plate with driving mechanism

All working parts are readily accessible. The entire indicating and recording apparatus is attached to one plate, and the driving mechanism, including the motor, to another. Both plates may be removed by loosening a few wing-screws, their removal opening all gas passages over their entire length. Connection between the humidifier compartments and the measuring chambers is established by channels of ample cross-section.

Corrosion-resistant materials, such as bakelite and special alloy steels, are used for parts in contact with flue gas. The machine is inclosed in a dust-proof aluminum casing available for wall or panel mounting.

The standard 9-in. scale and circular chart 8 in. in diameter are graduated from 0 to 20 per cent CO_2. Scales from 0 to 30 per cent CO_2 for blast furnace gas and 0 to 40 per cent for lime kilns are also available. The recording mechanism is driven interchangeably by a spring clock or an electric clock, as desired.

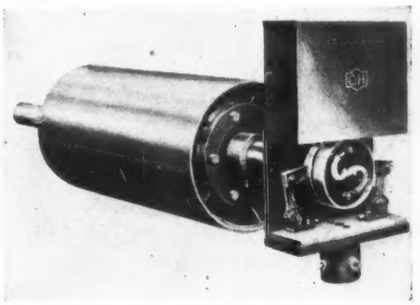
Other instruments of recent development embodying the same principle and general design are a specific gravity recorder with circular chart and a special recorder for the control of butane-air mixing. This machine has a specific gravity range from 1.0 to 1.2 with a superimposed adjustable scale graduated in B.t.u. per cubic foot.



Ranarex wall-type CO_2 indicator and recorder

Magnetic Separator Pulley

THREE major parts—a machined cast steel spool, magnet coils and a coil shield—with the necessary insulation constitute the new type "W" magnetic separator pulley announced by Cutler-Hammer, Inc., 190 12th St., Milwaukee, Wis. The magnet coils are wound on the steel spool and vacuum-impregnated. The coil shield of Allegheny metal is then welded to the spool so that it completely incloses the coils.



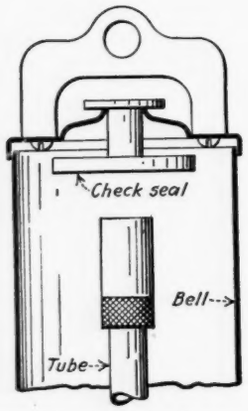
Magnetic pulley with dustproof cover in raised position

The commutating mechanism, which conducts the current to the magnet coils, is mounted on one end of the pulley shaft. Heavy brass collector rings and carbon brushes are used. A dustproof cover protects the rings from dust and other flying particles and protects operators from accidental contact with live parts. Pulleys in 12-in. diameter size and in six lengths, for belt widths varying from 12 to 30-in., are available.

Check Seal for Draft Gages

FOR SEALING gasometer bell-type draft gages against drawing out oil under periods of excess minus drafts, a "check seal" has been developed by the Ellison Draft Cage Company, 214 West Kinzie St., Chicago, Ill.

The seal is built into the top of the bell and consists of a double check-valve, one above and one below the bell head. On the downward movement of the bell, slightly in excess of the scale range, the disk be-



Seal prevents oil being drawn out of gage under exceess minus drafts

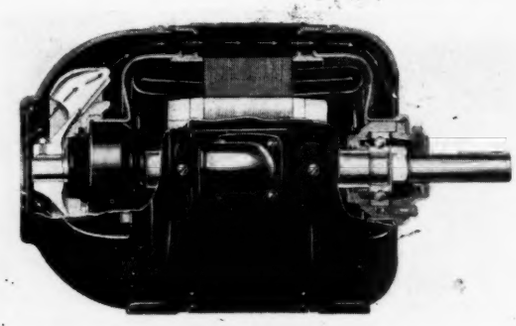
low the bell head closes over the end of the draft tube, shuts off the draft from the bell, releases any excess through the top check, and holds only the established draft in the bell until normal operating conditions are restored. The double-action check insures positive sealing for any suction head under all conditions.

It is also installed in gages of plus readings where the pressure may change momentarily from minus to plus, or where the induced-draft fan is started up ahead of the forced-draft fan.

Inclosed Motors With External Cooling Fan

THE NEW LINE of dust-tight totally enclosed fan-cooled induction motors recently announced by the General Electric Company, Schenectady, N. Y., provides a totally inclosed motor of the same mounting dimensions, rating for rating, as the standard G. E. open-type, horizontal, general-purpose motor, from ¾ to 50 hp. These motors are equipped with ball bearings, in "cartridge" housings, and utilize a single ventilating fan located outside the inclosure on a short shaft extension. A double frame is used, providing air passages for the ventilating air.

The use of dust-tight, cartridge-type ball-bearing housings permits removal of the rotor without exposing the bearings to dust or dirt.

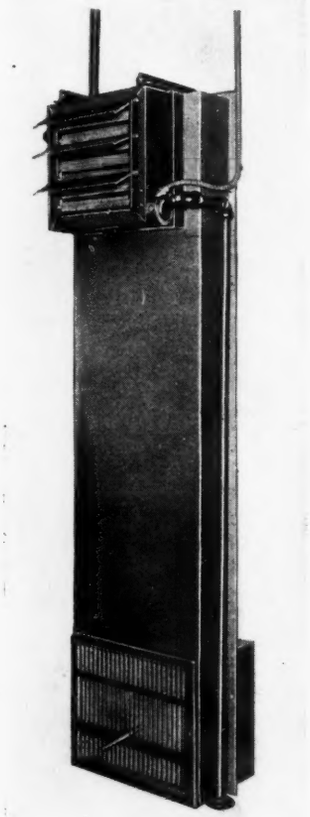


Cut-away view of air-cooled motor

Cabinet Unit Heater

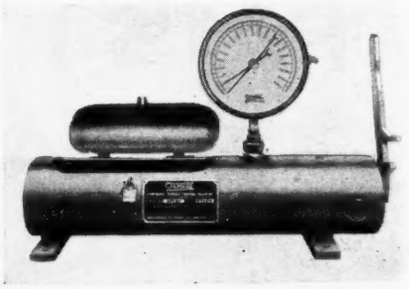
AMONG recent developments of the Wolverine Tube Company, Detroit, Mich., is a cabinet unit heater that provides an intake through the wall of the building as an alternate source of air. A damper permits either one or both air inlets to be used at the same time. Summer ventilation with outside air is thus possible, as well as winter ventilation with inside air. Immediately above the air inlets is a steel-wool air filter that is readily removable for cleaning.

A standard Wolverine unit heater is used. It has airplane-type fan and



Cabinet-type heater

individually adjustable louvers. The cabinet has a flush panel door through which the motor of the heater may be reached. The unit is designed for hot water, vapor or steam and is suitable for use on high-pressure lines.



Oxweld portable tensile-testing machine

Portable Machine for Testing Welds

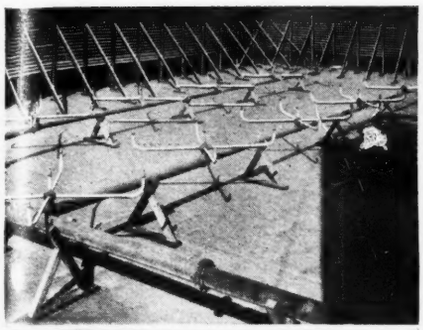
OXWELD ACETYLENE COMPANY, 30 East 42d St., New York, has brought out a portable tensile-testing machine designed to facilitate testing of welds in the field or shop. The machine weighs 165 lb. and measures 28 in. in over-all length and 6¾ in. in maximum diameter. It consists of a tubular compression member with a set of grips in the head and a hydraulic cylinder block in its base. The cylinder block contains a communicating pump and cylinder directly machined into a single block, and the cylinder pressure operates a piston carrying a second set of grips.

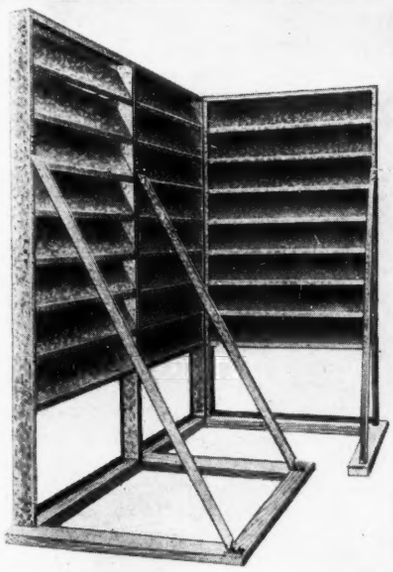
The welded specimen to be tested is placed between the jaws, which have spring grips. Pressure is applied by operating the pump, the load being measured directly in pounds per square inch by a gage actuated by the pressure in the cylinder. When a test is finished the pressure is released by a valve and the piston returned to its original position by using the pump handle as a lever.

Sectional Steel Louver Fencing for Spray Ponds

A RECENT addition to the line of spray sand equipment put out by Binks Manufacturing Company, 3114 Carroll Ave., Chicago, is sectional steel louver fencing in standard sections 5 ft. wide and in 9, 12 and 14 ft. heights. Narrow sections ranging in widths from 2 to 4 ft. are also available.

The framework of the fence is made up of 16-gage heavily galvanized material with 18-gage louver plates riveted in position. Each section is furnished complete, ready for installing and provided with a series of holes on each side of the frame so that adjustments can be made for the pitch of the roof. The 9-ft. fence is





Typical installation and inside view of corner assembly

said to give ample drift spray protection for the average installation, the 12-ft. fence being for special applications. The 14-ft. fence is used on double-deck spray ponds where nozzles must necessarily be elevated considerable distance above the spray deck.

New Indicating Pyrometer Controller

IN THE model 801 indicating pyrometer controller put out by the Brown Instrument Company, Philadelphia, Pa., the control mechanism combines the basic principle of the Brown automatic control recorder, with a feature of mercury contacts for breaking high current.

Pyrometer controller with mercury switch

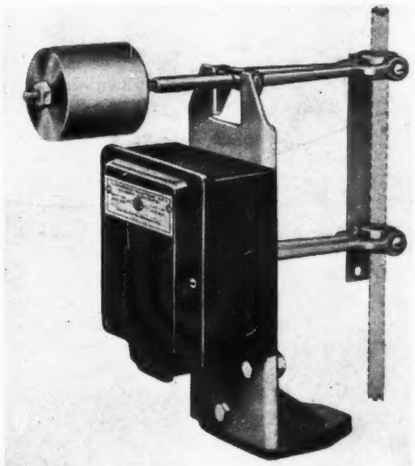
In this new instrument, which can be supplied as a control pyrometer, resistance thermometer, tachometer or CO_2 meter, the reading is observed directly on a 6-in. scale. All wiring terminals and motor are completely inclosed, making the instrument safe for use in explosive or inflammable gases. Also, the high capacity of the mercury switch eliminates the danger from sparking and the necessity of relay equipment.

Other features of the instrument are a safety device that opens the furnace circuit if thermocouple or wiring fails, and automatic internal compensation eliminating cold junction errors when the instrument is used as a pyrometer.

Automatic Float Switch

THE automatic float switch, bulletin 840, recently announced by the Allen-Bradley Company, 1311 South First St., Milwaukee, Wis., is of the contactor type operated by an arm working against a cam leverage.

Size B float switch is made in four forms in various combinations with or without overload breakers, disconnect switches, and fuse clips. It provides two-pole switching and handles alternating-current motors up to 1½ hp., 110 volts and 3 hp., 220, 440 and 550 volts; the direct-current rating is 1 hp. 110 or 220 volts.



Contactor-type float switch

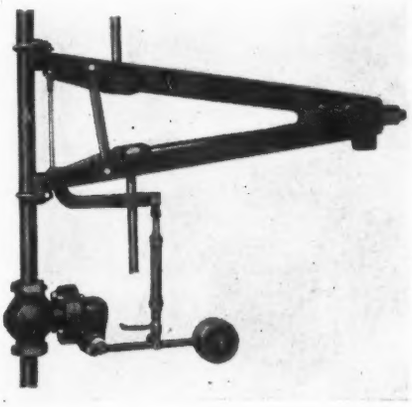
Size C switch provides three-pole switching and is rated for single-phase motors up to 1½ hp., 110 and 3 hp., 220 volts; for polyphase motors up to 3 hp., 110 and 5 hp., 220, 440, and 550 volts.

Feed-Water Regulator for Return-Tubular and Scotch Marine Boilers

DESIGNED to retain all the features characteristic of the Copes standard feed-water regulator, type OT, illustrated, has been introduced by the Northern Equipment Company, Erie, Pa., for use with horizontal return-tubular Scotch marine and other boilers of similar type.

In type OT the thermostat is made up of two short tubes connected at an angle by a heavy bronze bend. Both tubes are in tension, and the operating effect is that of a single tube. The standard Copes regulating valve is used.

The illustration shows the method of installation with regulating valve in a vertical feed line. The thermostat is clamped to the feed line and no other support is necessary. If the valve goes into a horizontal line the thermostat is supported by two sections of 1-in. pipe screwed in holes in the thermostat and clamped at the lower end to the horizontal feed line.



Type OT regulator with control valve in vertical feed line

A tension relief is provided in the connection between the thermostat and valve to relieve tension strains on the strut connection. Regulating valves for use with the type OT range in size from ¾ to 2 inches.

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A ONE-COAT high-gloss black lacquer, extremely high in luster and durability, is being produced by the Agate Lacquer Manufacturing Company, Inc., 11-13 43d Road, Long Island City, N. Y. The lacquer is capable of application to all metals, including brass, copper and iron. It is marketed in addition to the buffing lacquer which the company produces.

NEWS of the FIELD

Live Program Announced for A.S.H.V.E. Meeting in Pittsburgh, Pa., Jan. 26-29

Progress of heating and ventilating, applications of air conditioning, welded piping, insulation and research among subjects to be discussed

ANNOUNCEMENT has just been made of a program of lively and interesting technical papers for the 37th annual meeting of the American Society of Heating and Ventilating Engineers to be held at the William Penn Hotel in Pittsburgh, Pa., from Jan. 26 to 29, 1931. Included among the subjects scheduled for discussion at the gathering are the progress of heating and ventilating, applications of air conditioning to industry, welded piping for heating systems, insulation and research activities.

The meeting will be called to order by President L. A. Harding, at 2 p.m. on Monday, Jan. 26 at the William Penn Hotel, and on each day thereafter technical sessions will be held. On Wednesday all scheduled events will be transferred to the A.S.H.V.E. Research Laboratory at the United States Bureau of Mines Experiment Station where a technical program will be given in the morning and the afternoon will be devoted to inspection.

In addition to an attractive program of technical papers, consideration will be given to several codes which have been developed during the past year; two of which have already been reported to the council are the Code on Oil Burning Devices and the Code for Testing and Rating Concealed Gravity Type Radiation.

Some of the papers that have been offered for the meeting include the following subjects:

"Progress of Heating and Ventilating During the Past Quarter Century," R. P. Bolten; "Developments in Heating and Ventilating During 1930," S. R. Lewis; "Development of the Ventilation System of the Holland Tunnel," A. C. Davis; "Air Conditioning in the Bakery," W. L. Fleisher; "Report of the Research Committee," F. B. Rowley; "Capacity of Return Mains for Steam and Vapor Heating Systems," F. C. Houghton; "Welded Piping for Building Heating Systems," F. G. Outcalt.

"Air Pollution From the Engineers' Standpoint," H. B. Mellor; "Smoke and Dust Abatement," M. D. Eagle; "Special Distribution of the Energy Radiated From Metallic Surfaces at High Temperatures," G. R. Greenslade; "Insulating Effect of Successive Air Spaces Bounded by Bright Metallic Surfaces," L. W. Schad; "Utilization of Hot Springs for Heating in Iceland," Ben Grondal; "Off-Peak System of Electric Heating," Elliott Harrington; "Heating With Exhaust Steam," Perry West.

Five Commission Nominees Recommended to Senate

With all of the five nominations to the Federal Power Commission reported upon favorably Dec. 17 by the Senate Committee on Interstate Commerce, indications were at the time of going to press that a new commission would be functioning this week. Confirmation by the Senate of those five—George Otis Smith, Marcel Garsaud, Claude L. Draper, Frank R. McNinch and Ralph B. Williamson—seemed a certainty.

Dr. George Otis Smith, director of the United States Geological Survey, who had been nominated by the President to be chairman of the commission, was subjected to an extended examination by the Senate committee as to his views concerning the principal controverted questions which have arisen in the administration of the water-power act. Dr. Smith expressed his views freely but declined to make any pledges or promises. He frankly expressed his conviction that private operation of water-power projects is greatly to be desired over public operation. He made it clear, however, that he realizes that it is the intent of the water-power act to give preference to states and municipalities that may apply for rights and that he would vote for the public project when it is in a position to make comparable use of the resources.

Dr. Smith declined to express approval or disapproval of the attorney general's opinion in the New River case. He said he had had no opportunity to study the facts involved but that as a general proposition he favored state regulation. In cases where regulation is not accomplished by the state, the federal government would have to fill the gap. Insofar as interstate transmission of power is concerned, Dr. Smith asserted his belief that it can be regulated successfully with full recognition of both state and federal authority.

Only perfunctory questions were asked of Claude L. Draper of Wyoming and Ralph B. Williamson of Oregon. Frank R. McNinch of North Carolina and Marcel Garsaud of Louisiana had no such clear sailing. The opposition to Mr. McNinch came largely from regular Democrats.

The opposition to Mr. Garsaud came from his own state. He is allied with the political faction which opposed Governor Huey P. Long when the latter recently was victorious in a race for the Senate. At the request of the governor three Louisiana witnesses appeared in an effort to establish Mr. Garsaud would be inclined to favor power companies in his decisions because he is indebted for past employment to several members of the board of directors of the utility company operating in New Orleans. It was contended that the opposition to Mr. Garsaud was political. Evidence was brought forward to show that the men responsible for previous positions held by Mr. Garsaud and for some consulting work which he had done, were not of the type who would attempt to suggest how he should carry out his office.

Complete Large Hydro Project in Scotland

Inauguration of the $8,750,000 scheme for utilizing the water of Loch Ericht in Scotland for the supply of electric power has just taken place. George Balfour, M.P., performed the ceremony by pressing a switch linking the system with that of the Central Electricity Board at Abernethy for Scottish distribution.

The project involves raising the level of Loch Ericht 13 ft., excavating two and three-quarter miles of hill tunnel, the erection of a power house with two turbines of 20,000 hp. each and the erection of lines and cables between Rannoch and Abernethy. The work

was begun in September, 1928, and has been carried through with approximately 1,000 men continuously employed. A beginning has been made with an extension of the original scheme by constructing a dam on the Tummel River below Kinloch Rannoch, with a second power house at Tummel Bridge, which is expected to be completed in about two years.

Western Metal Congress Plans Taking Shape

Plans are beginning to take shape for the National Western Metal Congress and the National Western Metal and Machinery Exposition to be held in the Civic Auditorium, San Francisco, Calif., Feb. 16-20. Arrangements already have been made by the American Institute of Electrical Engineers and the Pacific Coast Electrical Association to have a joint session at the convention. A. W. Copley, Westinghouse Electric & Manufacturing Company, San Francisco, representing the A.I.E.E., and R. H. Halpenny, The Southern Sierras Power Company, Riverside, chairman of the Engineering Section, P.C.E.A., will be in charge of the program for that session. One of the important subjects to be discussed will be electric furnaces and electrical industrial heating.

The first National Western Metal Congress and National Metal and Machinery Exposition were held two years ago in Los Angeles.

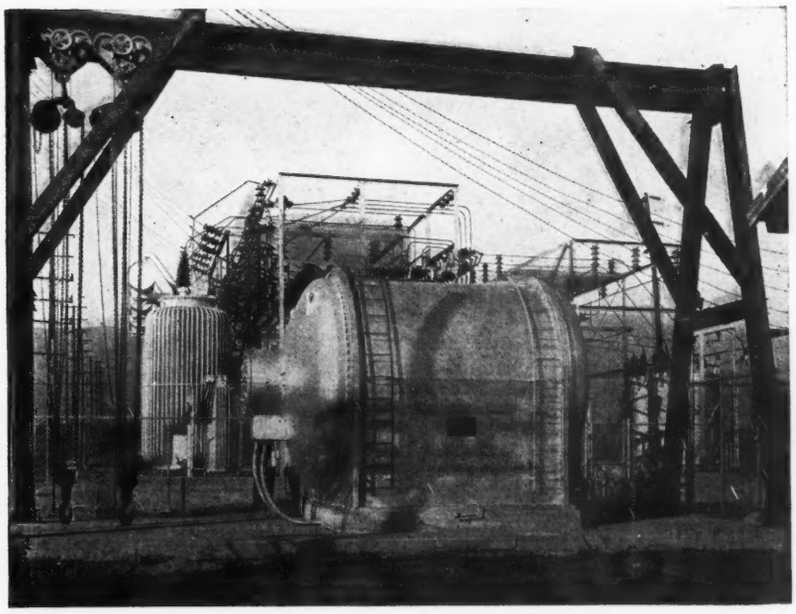
Arrangements for the present congress and exposition are in the hands of W. H. Eisenman, Cleveland, secretary of the American Society for Steel Treating, who has opened headquarters in the Civic Auditorium Building.

The societies co-operating in the convention are: American Chemical Society; American Institute fo Electrical Engineers; American Institute of Mining and Metallurgical Engineers; American Petroleum Institute, California Division; American Society of Mechanical Engineers; American Society for Steel Treating; American Welding Society; Institute of Metals; National Purchasing Agents Association; Pacific Coast Electrical Association; Pacific Coast Gas Association; and Society of Automotive Engineers.

California Commission Adopts New Procedure

Announcement has been made by the California Railroad Commission that recent revisions made in its rules of procedure have been printed and are available for distribution. These rules, which are of particular interest to attorneys and others appearing before the commission, govern the preparation and filing of applications and complaints. Important changes have been made in several of the rules, the most extensive being made in the rule governing the preparation of applications for new highway grade crossing construction by cities, counties and railroads. Copies of the rules will be furnished to all interested persons upon application to the offices of the commission at San Francisco or Los Angeles.

SOUTHERN CALIFORNIA'S NEW UNIT



Installation of the first outdoor, hydrogen-cooled synchronous condenser on the Southern California Edison Company system has been completed at the San Antonio substation. The condenser, manufactured by the Westinghouse Electric & Manufacturing Company, is rated at 15,000 kva., and the cost of installation, including transformers and oil switches, was $170,000

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Sugar Factory Opens New Boiler Plant

The Great Western Sugar Company's twenty-second beet sugar factory was recently completed at Wheatland, Wyo., and put into operation. The new plant has a daily slicing capacity of 1,400 tons. Three 6,000-sq.ft. boilers, requiring 150 tons of coal per day, are the source of power and are the largest units of their kind operated by the sugar company. In conformity with modern methods, the Wheatland plant lacks the high stacks so familiar in plants of an earlier era. Draft for the Wheatland furnaces is furnished by an induced draft fan.

The first-effect evaporator is the largest in any Great Western plant, having 6,735 sq.ft. of heating surface; and calandria vacuum pans are used exclusively for boiling both raw and white sugar. This means that no high-pressure steam will be required from the boilers for the boiling of sugar. The mill is rated to produce 264 lb. of sugar per minute.

News of Canada

Calgary to develop Athabaska —Power output shows gain— Nova Scotia plans extensions —Vote addition to Winnipeg plant

CALGARY POWER COMPANY of Calgary, Alberta, which recently completed the building of the Ghost River plant, will commence surveys next spring on a power site on the Athabaska River northwest of Edson for a dam and power house ultimately to cost $5,000,000. The company's engineers have been investigating for some time in a preliminary way the prospects for new sources of power in the northerly part of the province. With the recent growth of the company's distribution system to include the supply of power to Edmonton and to towns east and north of the Alberta capital, it became necessary to locate power sites for future development. Both the Saskatchewan and Athabaska Rivers are being studied in this connection. The site on the Athabaska was first investigated by the Montreal Engineering Company for the Calgary Power Company in 1911 and was favorably reported on at that time. It is estimated that a dam of 100-ft. elevation, if not more, could be constructed there.

STATISTICS covering the output of central electric stations in Canada during

the month of October show a gain in the production generated by water power but a falling off in output of fuel plants. The aggregate for all central power stations totalled 1,549,286,000 kw.-hr. This compares with 1,427,961,000 in the preceding month. Of the total in October, 1,524,573,000 kw.-hr. were generated by water power and 24,713,000 by fuel. In October a year ago water power plants produced 1,559,042,000 kw.-hr. and fuel plants 35,241,000. Export of electrical energy during October reached the highest point for any month recorded in some years, the total being 161,323,000 kw.-hr. This is roughly 8,000,000 more than in September and nearly 35,000,000 over the output for October, 1929.

EXTENSION of power services in the province of Nova Scotia will take the form of construction of an inter-connecting transmission line between developments on the Mersey and Mush-a-Mush Rivers, which has just been authorized by the Nova Scotia Power Commission. This line will transmit standby service and auxiliary power and energy to the Mush-a-Mush system. At present there is an interconnection between the commission's system on the Mush-a-Mush River and the Bridgewater hydro-electric station at Hebbville. Seven miles of the Mersey-Hebbville route is already covered by a transmission line which supplies power and energy to South Brookfield and Caledonia. The proposed line will extend from the Caledonia-Liverpool road across country 21 miles to connect with the Mush-a-Mush system through the Bridgewater hydro-electric station.

ADDITIONS to the city of Winnipeg's publicly owned steam heating plant, which now involves the investment of several million dollars, were sanctioned by a vote of property owners at the recent civic elections. The city hydro system, under which the steam heating plant is operated, sought endorsement of a $750,000 bylaw which provides for extension of the heating service to residential areas of the city. It has been a success in the warehouse and business section of the city, and indications point to its success in the residential section.

Longmont, Colo., to Build 1,000-Kw. Diesel Plant

Construction of a diesel engine auxiliary municipal light plant to cost $142,000 has been authorized by the city council of Longmont, Colo. This new plant will enable the town to produce its own electricity by Jan. 1, 1932. For a number of years the municipality has purchased power from Public Service Company of Colorado to supplement the Longmont hydro-electric service, which became inadequate. The proposed diesel plant is to have a capacity of 1,000 kw.

COMING CONVENTIONS

American Society of Mechanical Engineers. National Fuels Meeting in Chicago, Ill., Feb. 10-13, 1931. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Engineering Council. Annual meeting at the Mayflower Hotel, Washington, D. C., Jan. 15-17, 1931. Secretary, L. W. Wallace, 26 Jackson Pl., N.W., Washington, D. C.

American Institute of Electrical Engineers. Annual Winter convention in New York City, Jan. 26-30, 1931. Secretary, F. L. Hutchinson, 33 West 39th St., New York City.

American Society of Heating and Ventilating Engineers. Annual meeting at the William Penn Hotel, Pittsburgh, Pa., Jan. 26-29, 1931. Secretary, A. V. Hutchinson, 51 Madison Ave., New York City.

Engineering Institute of Canada. Annual meeting at the Windsor Hotel, Montreal, Que., Feb. 4-6, 1931. Secretary, R. J. Durley, 2050 Mansfield St., Montreal, Que.

Midwest Power Engineering Conference and Exposition. Fifth meeting in Chicago, Ill., Feb. 10-13, 1931. Secretary, George E. Pfisterer, 308 West Washington St., Chicago, Ill.

National Marine Engineers' Beneficial Association. Annual convention at the Lee House Hotel, Washington, D. C., Feb. 9-15, 1931. Secretary-treasurer, Albert L. Jones, 313 Machinists Building, Washington, D. C.

Obituary

ANDREW MURRAY HUNT, mechanical, electrical and chemical engineer, died in Berkeley, Calif., Dec. 8. He was 71 years old. He graduated from the Naval Academy at Annapolis in 1879. While in the Navy he was loaned by the Government to San Francisco to become chief of the department of mechanical arts at the Mid-winter Fair in 1894. Following the fair he left the Navy and set up his own business in San Francisco as a consulting engineer. While conducting his own business he acted as consulting engineer for Claus Spreckels in the erection of a plant for the Independent Electric Light & Power Company, San Francisco, of which he became general manager. In 1904 he founded the firm of Hunt, Mirk & Company. For two years he devoted his entire time to the business of the firm and following that acted in an advisory capacity until 1913 when the business was sold. Until quite recently Mr. Hunt continued in the capacity of a consulting engineer, spending part of his time in New York City. He was a member of the American Society of Civil Engineers, of which he was vice-president during the year 1921-22; American Society of Mechanical Engineers; American Society of Chemical Engineers; American Institute of Electrical Engineers.

Personals

CHARLES EDWARD SKINNER, assistant director of engineering of the Westinghouse Electric & Manufacturing Company, has been nominated for president of the American Institute of Electrical Engineers for the year 1931-32. For vice-presidents the following were nominated: W. B. KOUWENHOVEN, assistant dean of the engineering school at John Hopkins University; W. E. FREEMAN, assistant dean of the college of engineering at the University of Kentucky; P. H. PATTON, Northwestern Bell Telephone Company; A. W. COPLEY, Westinghouse Electric & Manufacturing Company; L. B. CHUBBUCK, Canadian Westinghouse Company. WALTER I. SLICHTER, head of the department of electrical engineering at Columbia University, has been elected treasurer of the Institute to succeed GEORGE A. HAMILTON, who occupied the post for 35 years.

W. F. SIMS has been appointed engineer of inside plant of the Commonwealth Edison Company of Chicago. Since October, 1929, Mr. SIMS has been discharging the duties of this position in the absence of B. G. JAMIESON, who at that time took a year's leave of absence to make a trip around the world. Mr. Jamieson has decided to remain abroad and for the present will make his home in Paris, France.

E. A. HESTER, planning engineer of the Duquesne Light Company of Pittsburgh, has been appointed vice-chairman of the National Electric Light Association committee on power systems engineering.

BANCROFT GHERARDI, vice-president and chief engineer of the American Telephone & Telegraph Company, was recently elected president of the American Standards Association. CLOYD M. CHAPMAN, engineering specialist of New York City, was re-elected vice-president of the association and appointed chairman of its Standards Council. JOHN C. PARKER, vice-president in charge of engineering of the Brooklyn Edison Company, was appointed vice-chairman of the council.

VIRGIL M. PALMER, president of the Rochester Engineering Society and industrial economy engineer with the Eastman Kodak Company of Rochester, N. Y., is recovering from the effects of a serious operation he underwent the latter part of last month.

CLAXTON E. ALLEN, formerly manager of the Southwestern district of the Westinghouse Electric & Manufacturing Company, was elected a commercial vice-president of that company at a recent meeting of its board of directors. Mr. Allen is a fellow of the American Institute of Electrical Engineers and has been vice-president of the St. Louis Electrical Board of Trade.

Business Notes

BABCOCK & WILCOX COMPANY, New York City, announces that the manufacturing operations of its subsidiary, the FULLER LEHIGH COMPANY, are to be transferred from Fullerton, Pa., to the Barberton, Ohio, works of the B. & W. company. Management, engineering and sales departments of Fuller Lehigh will be moved to New York City. No definite date has been set for these changes, but it is expected that they will be made early in 1931. The corporate identity of Fuller Lehigh will be maintained, according to the announcement, but in some cases the personnel will be merged with that of the parent company. It is also announced that E. G. Bailey, president of the Fuller Lehigh Company, has been elected a vice-president of the Babcock & Wilcox Company.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., announces important changes and improvements at its South Philadelphia, Pa., works, involving expenditures in excess of $300,000. Plans for the alterations and additions, which have been under consideration for some time, include conversion of part of the manufacturing space into a new shop where all locomotive equipping and testing activity, in connection with Westinghouse oil-electric and electric locomotives, will be concentrated. Hitherto, this work has been carried on at the East Pittsburgh works of the company.

NEILAN COMPANY, LTD., Los Angeles, Calif., announces the appointment of Arthur J. Foley as manager of its Chicago branch office. Mr. Foley is widely known throughout the Middle West due to his years of experience in connection with numerous industrial plant installations. His office will be at 55 East Wacker Drive, Chicago, Ill.

TAYLOR INSTRUMENT COMPANIES, Rochester, N. Y., announces that Samuel H. Worswick, their Pacific Coast representative for the past sixteen years, with headquarters in San Francisco, Calif., has resigned, effective Jan. 1. His successor is G. H. Linsley, Jr., who has been associated with the Taylor companies in San Francisco for the past few years.

UTILITIES ELECTRICAL MACHINERY COMPANY, a newly organized corporation located in the Utilities Building, 2027 East 105th St., Cleveland, Ohio, will officially commence functioning as a buyer and seller of large used electrical equipment on Jan. 1. J. W. Kohn is president and M. S. Kohn, general manager of the new concern.

ALLEN-BRADLEY COMPANY, Milwaukee, Wis., announces the appointment of J. K. Webb as sales representative in the Texas territory. Mr. Webb's office is located at 601 Allen Building, Dallas, Texas.

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How's Business?

AS WE DRAW nearer the end of this year there are a few faint signs that business is beginning to pull itself together in preparation for an effort to turn the tide when the next one begins. Resistance to further decline has stiffened slightly, as the wave of liquidation has become heavier. Although our index of business activity fell somewhat further, from 77.5 per cent of normal to 76.3 per cent, steel production held up against the usual seasonal down trend, electric power production was fairly well sustained, merchandise carloadings were somewhat higher than the seasonal expectation, and the volume of commercial loans and currency in circulation continued to expand. Firmness in steel prices is being maintained, and both security and commodity markets give encouraging indications of reaction to excessive liquidation under more deliberate support.—*The Business Week*, Dec. 24.

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Trade Catalogs

UNIT HEATERS — Catalog No. 469 just issued by the Buffalo Forge Company, 490 Broadway, Buffalo, N. Y., illustrates and describes five different types of unit heaters for industrial and building applications. Construction details of the units are shown, and helpful suggestions are included on choosing the right type and size of heater.

TERMINATORS—The Delta-Star Electric Company, 2400 Block, Fulton St., Chicago, Ill., has just issued a new bulletin, No 65-B, describing terminators for use in sealing the ends of high-voltage cables. A complete listing of wet and dry flashover values are given.

LOW - TEMPERATURE INSULATION—The 1931 edition of the "Handbook on Insulation" has just been issued by the United Cork Companies, Lyndhurst, N. J. This unusual book represents the co-ordination of experience acquired by the companies during more than 25 years in the refrigerating industry. Complete and up-to-the minute, the book contains technical data, construction methods, insulation details, blueprint specifications and manufacturer's catalog information.

BLOWER AND REGULATOR—Catalog 24 of the Power Turbo-Blower Company, 350 Madison Ave., New York City, describes and illustrates Power and Simplex turbine-blowers. Construction details, capacities, applications and installation instructions are given in the catalog. Another new publication of the company, Bulletin D 24, describes the Standard P.&S. damper regulator for controlling high- and low-pressure boiler units.

COMBUSTION SYSTEMS—Details of Esenco combustion systems, boiler settings and furnace linings are given in an illustrated folder recently issued by the Essex Engineering Company, Belleville, N. J.

PULVERIZER—The new Type B pulverizer is described and illustrated in Bulletin 5-80 recently issued by the Fuller Lehigh Company, Fullerton, Pa. Outstanding features of the pulverizer's construction and operation are explained in the bulletin.

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Fuel Prices

FUEL OIL

New York—Dec. 18, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.5c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 6c. per gal.

St. Louis—Dec. 5, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.345 per bbl., or 42 gal.; 26@28 deg., $1.47 per bbl.; 28@30 deg., $1.595 per bbl.; 30@32 deg., $1.695 per bbl.; 32@36 deg., gas oil, 3.901c.@4.026c. per gal.; 38@40 deg., distillate, 4.651c.@4.776c. per gal.

Pittsburgh—Dec. 11, f.o.b. local refinery, 34@36 deg., fuel oil, 3.37½c.@3.5c. per gal.; 36@40 deg., 3.37½c.@3.5c.

Philadelphia—Dec. 16, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 18 deg. plus, $1.26@$1.31 per bbl.; 23@27 deg., $2.00@$2.05 per bbl.

Cincinnati — Dec. 16, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5.25c. per gal.; 26@30 deg., 5.5c. per gal.; 30@32 deg., 5.75c. per gal.

Chicago—Dec. 11, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 70c. per bbl.; 26@30 deg., 80c.@90c. per bbl.; 30@32 deg., $1.00@$1.05 per bbl.

Boston—Dec. 15, tank-car lots, f.o.b. 12@14 deg., Baumé, 2.9c. per gal.; 28@32 deg., 4.85c. per gal.

Dallas—Dec. 13, f.o.b. local refinery 26@30 deg., $1.10 per bbl. or 42 gallons.

COAL

Bituminous (Net Tons)	At Mine, for Shipment to	Price per Ton
Pool 9, super low-vol.	New York	$1.90 @ $2.25
Pool 10, hr.gr. low-vol.	New York	1.75 @ 1.85
Pool 11, low-vol.	New York	1.60 @ 1.75
Smokeless, mine-run	Chicago	1.75 @ 2.25
Smokeless, slack	Chicago	.50 @ 1.50
Harlan, Ky., slack	Chicago	.50 @ .90
Franklin, Ill., mine-run	Chicago	2.15
Franklin, Ill., screen	Chicago	1.10 @ 1.60
Ind. 5th Vein, m.-r.	Chicago	1.50 @ 1.85
Standard Ill., mine-run	St. Louis	1.70
W. Ky., mine-run	Louisville	1.00 @ 1.35
W. Ky., slack	Louisville	.15 @ .30
Pittsburgh, mine-run	Pittsburgh	1.30 @ 1.60
Smokeless, mine-run	Cincinnati	1.75 @ 2.25
Smokeless, slack	Cincinnati	.75 @ 1.35
Kanawha, mine-run	Cincinnati	1.10 @ 1.35
Kanawha, nut-slack	Cincinnati	.35 @ .50

Anthracite (Gross Tons)	At Mine, for Shipment to	Price per Ton
Buckwheat	New York	$3.00
Barley	New York	1.15 @ 1.50

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Calif., San Francisco—Bd. of Regents of University of California, Berkeley, is receiving bids for the construction of a power plant at Third and Parnassus Aves. Estimated cost $40,000. W. C. Hays, Crocker First National Bank Bldg., is engineer.

Calif., San Francisco—Constructing Quartermaster, Fort Mason, is having plans prepared for the construction of a central heating plant including three 100 hp. boilers, oil burners, underground distribution lines, and changing all water heating plants to steam at Fort McDowell.

Calif., Turlock—City, J. Brown, City Supt. of Waterworks, plans the construction of fifth auxiliary pumping plant in connection with municipal waterworks.

Ga., Macon—T. B. Buck, Columbus, 2012 Talbottom Ave., Columbus, plans the construction of a 1 story ice plant. Estimated cost $60,000.

Ill., Chicago—Commonwealth Edison Co., 72 West Adams St., awarded masonry and carpentry contracts for a 1 story, 44 x 60 ft. sub-station at 121 North Dearborn St., also 1 story, 27 x 32 ft. sub-station at 10166-68 Malta St. and 1 story, 73 x 118 ft. addition to laboratory at 3507-11 North California Ave. Estimated total cost $78,000.

Ill., Edwardsville—American Telegraph & Telephone Co., 829 Telephone Bldg., St. Louis, Mo., awarded contract for the construction of a telephone booster station including repeater equipment here to Hellrung Construction Co., Alton $62,000. Owner also plans similar plants at Jewett and Vandalia; 174 miles of long distance telephone cable line between St. Louis, Mo. and Terre Haute, Ind. and 30 mi. of underground cable line. Latter will be done by owners forces. Total estimated cost $3,000,000.

Ill., Elsah—Principia School, 5457 Page Blvd., St. Louis, Mo., is having preliminary plans prepared for the construction of a group of college buildings including power house, etc. near here. Estimated cost $3,500,000. B. Maybeck, Berkeley, Calif, is architect.

Ind., Evansville — County Commissioners, awarded contract for the construction of a power house at County Infirmary to W. Graul, 317 Edgar St. Estimated cost $65,000.

Kan., Kansas City—Bd. of Public Utilities, C. A. Lowder, Secy., 406 Interstate Bldg., awarded contract for coal handling equipment, to include coal crusher and conveyor, etc. to Stearn Co., 1021 Euclid Ave., Cleveland, O. $48,668, also ash handling equipment to Allen-Sherman-Hoff Co., Lewis Bldg., Philadelphia, Pa. $42,315.

Kan., Kansas City—Burns & McDonell Engineering Co., 408 Interstate Bldg., Kansas City, Mo., will receive bids until Dec. 29 for structural steel for 95 x 125 ft. power plant for City.

Kan., Topeka—City awarded contract for a water storage reservoir and pump house in connection with waterworks system to F. M. Spencer & Son, 1805 Harrison St. Estimated cost $119,500.

Kan., Wichita—Western Hotel & Bldg. Co., c/o J. W. Gerhardt, 425 North Topeka, has awarded contract for construction of 18 story, 110 x 159 ft., hotel, to Fisher Construction Co., 320 North Michigan Ave., Chicago, Ill. Estimated cost $1,500,000. Contractor taking bids on all sub-contracts.

La., Baton Rouge — State, H. P. Long, awarded general contract for a 33 story capitol building, to G. A. Fuller Co., Munsey Bldg., Washington, D. C., heating and plumbing to American Heating & Plumbing Co., Inc., 829 Barome St., New Orleans; electrical equipment to Evans Bros., 511 Magazine Bldg., Baton Rouge. Estimated total cost $5,000,000.

Md., Baltimore — Mayor and City Council, City Hall, awarded contract for the construction of a 4 story 101 x 258 ft. junior high school at Caroline and McElderry Sts. to Henry L. Maas & Son, 1119 Ensor St. Estimated cost $700,000. Vacuum heating system, etc. will be installed.

Mass., Boston—Edison Electric Illuminating Co., 39 Boylston St., plans addition to steam heating plant at Kneeland and Utica Sts. Estimated cost $40,000. Bigelow, Wadsworth, Hubbard & Smith, 11 Beacon St., are engineers.

Mass., Brookline—Edison Electric Illuminating Co., 39 Boylston St., Boston, is having plans prepared for the construction of a power substation on Beaconsfield Rd. Estimated cost $40,000 to $50,000. Private plans.

Mass., Charlestown (sta. Boston)—Bureau of Yards & Docks, Navy Dept., Washington, D. C., plans the construction of a steel storage plant and crane for marine railway at Charlestown Navy Yard. Estimated cost $2,000,000. Private plans.

Mass., Holsen—City of Worcester, received lowest bid for the construction of a pumping station on Quinapoxet Pond from Hallen & McCarthy, 95 Whitmarsh Ave. J. Rustigian, 16 Norwich St., is engineer.

Mass., Wellesley—Water and Municipal Light Commissioners, Taylor Block, are receiving bids for addition and alterations to power substation. Estimated cost $40,000. Private plans.

Mich., Detroit — Public Light Commission, East Atwater St., awarded contract for electrical work at Woodward Ave. terminal station, Philip Ave. sub-station and Luden switching station to Collier Construction Co., 721 Free Press Bldg.

Miss., Belzoni—Southern United Ice Co., F. I. McClandish, Ch. Engr., awarded contract for the construction of a 30 ton ice plant to S. P. Azwell, Belzoni.

Mo., Clayton—Syndicate c/o S. Hamberg, Jr., 1034 Arcade Bldg., St. Louis, will receive bids about Jan. 1 for the construction of a group of apartment buildings including steam heating and electric refrigeration systems at Blue Ridge Terrace here. Estimated cost $600,000. Maritz & Young Inc., 1116 Chemical Bldg., St. Louis, are architects.

Mo., Mountain Grove — City voted $20,000 bonds for waterworks improvements including deep well, new pump, main extensions, etc.

Mo., St. Louis—Terminal Railroad Association, 1800 Market St., and St. Louis Mart Inc., lessee, c/o H. C. Martin, 315 North 10th St., awarded contract for the construction of a 7 story merchandise mart building at 12th, Spruce, 13th and Poplar Sts. to Gamble Construction Co., 620 Chestnut St., $2,500,000.

N. J., Garfield—Garfield Crystal Ice Co., Midland Ave., will build a 2 story ice plant at Charles St. and Midland Ave. Estimated cost $75,000. Private plans. Work will be done by separate contracts.

N. J., Hackensack—Bd. of Chosen Freeholders, J. M. Harkness, Clk., Court House, will receive bids about Feb. 1 for the construction of a 6 story administration building including steam heating and ventilation systems, boilers, elevators, etc. at Main and Hudson Sts. Estimated cost $1,200,000. E. L. Tilton and W. F. Schwanewede, 420 Lexington Ave., New York, are architects.

N. Y., Bedford Hills — Dept. of Correction, State Capitol, Albany, is having preliminary plans prepared for power plant, additional boiler capacity and stokers, also refrigeration plant, storage building and laundry at New York State Reformatory for Women here.

N. Y., New York — Bd. of Transportation, J. H. Delaney, Chn., 250 Hudson St., awarded contract for block signalling and interlocking equipment for portions of Independent System of City owned Rapid Transit R.R. to General Railway Signal Co., 230 Park Ave., $2,178,000.

R. I., Providence—Narragansett Electric Co., Old Industrial Trust Bldg., awarded contract for a 2 story power sub-station at 146 Dyer St. to New England Power Construction Co., 89 Broad St., Boston. Estimated cost $40,000.

R. I., Providence—New England Power Association, 89 Broad St., Boston, Mass., awarded contract for the construction of a power sub-station at Eddy and Franklin Sts. here to New England Power Construction Co., 89 Broad St., Boston. Estimated cost $50,000.

Tenn., Memphis—City Commission, will receive bids until Jan. 7 for material for a new electric light plant sub-station on Talleyrand Ave. Work will be done by city forces.

Tex., Dallas — City, c/o E. Goforth, Secy., specifications for sewage disposal plant including six air compressors, etc., complete about Jan. 10. General plans ready about March. Estimated cost $1,700,000.

Texas, Near Mineral Wells—State Bd. of Water Engineers, Austin, is having surveys made for the construction of a large hydro-electric power dam on the Brazos River, also smaller dams for irrigation and municipal purposes. Estimated total cost approximately $15,000,000.

Tex., Taylor—E. A. Clausnitzer, New Braunfels, awarded contract for the construction of a 40 ton ice plant here to W. Sippel, New Braunfels. Estimated cost $45,000 including equipment.

Equipment Wanted

Air Compressor, Motor, Pumps, etc.—Washington, D. C.—A. L. Flint, General Purchasing Officer of the Panama Canal, will receive bids until Jan. 2 for air compressor, motor, water heater, portable pumps, etc.

Pump—Fairfield, Calif.—City plans to purchase pump, etc. for proposed waterworks system. Estimated cost to exceed $25,000.

Pump—Redlands, Calif.—City Council, is receiving bids for a 900 g.p.m. horizontal booster pump and motor, 300 lb. pressure, 60 cycle, direct connected for proposed waterworks system.

Pump — San Francisco, Calif. — Constructing Quartermaster, Fort Mason, plans furnishing and installing a two stage turbine pump, etc., at Fort Baker.

Pump, Etc.—Exeter, Calif.—City plans to purchase a deep well pump, etc. for proposed waterworks improvements.

Industrial Projects

Ala., Mobile—Champion Coated Paper Co., Hamilton, O., plans the construction of a paper mill near here. Estimated cost to exceed $1,000,000. Maturity indefinite. Also plans additions to paper mill at Hamilton. $150,000. This is part of proposed $1,000,000 expansion program.

Ga., Austell—Clark Thread Co., J. B. Clark, Pres., 715 Broad St., Newark, N. J., plans the construction of a thread spinning plant here. Estimated cost $2,000,000. J. E. Sirrine & Co., Greenville, S. C., are engineers.

Ill., Galesburg—Rowe Mfg. Co., A. Y. Rowe, Pres., 614 West Third St., manufacturers of farm implements, plans to rebuild 1 and 2 story plant recently destroyed by fire. Estimated cost $50,000. Architect not selected.

Ind., Hammond—W. J. Holliday Co., 545 West McCarthy St., (iron) awarded contract for a 220 x 225 ft. plant here to Austin Co., 510 North Dearborn St., Chicago, Ill. Estimated cost $100,000. Holliday Steel Co., Hammond, lessee.

Mass., Brockton—Brockton Gas Light Co., Inc., 54 Main St., is having preliminary plans prepared for addition to plant at Grove and Union Sts. Estimated cost $40,000. C. H. Tenney Co., 38 Chauncy St., Boston, are engineers.

Mass., Fitchburg—Crocker-Burbank Co., 545 Westminster St., is receiving bids for extension to power plant. Estimated cost $40,000. F. J. Sill, East Main St., Westboro, is engineer.

Mo., St. Louis — Glauser Meat Co., A. Glauser, Pres., 2130 Market St., will receive bids about Jan. 15 for the construction of a packing house, cooler building and warehouse at 704-706 South Spring Ave. Aegerter & Bailey, 1904 Railway Exchange Bldg., are architects.

Neb., Beatrice—Empire Gas Co., W. W. Smith, Res. Engr., awarded contract for the construction of a gas plant to Siedhoff Construction Co., Broadview Hotel, Wichita, Kan. Estimated cost $530,000. Private plans.

N. Y., St. George—Rubsam & Horrman Brewing Co., 191 Canal St., awarded contract for construction of a brewery, ice manufacturing plant and storage building to J. McDermott, Stapleton, S. I. Estimated cost $300,000.

N. Y., Syracuse—Pierce, Butler & Pierce, 41 East 42nd St., New York, will build a boiler and radiator manufacturing plant at Pearl and Canal Sts. here. Estimated cost to exceed $100,000. Work will be done by day labor and separate contracts.

N. C., Canton—Champion Fibre Co., Canton, N. C., c/o Champion Coated Paper Co., Hamilton, O., plans the construction of a paper mill. Estimated cost $150,000. Maturity in spring.

Pa., Vandergrift — Baher Findley Chemical Co., C. C. Baker, Pres., plans the construction of a 1 story, 40 x 150 ft. chemical plant here. F. Garrison, 310 Harrison Ave., Vandergrift, is architect.

Tex., Temple—Texas Pacific Coal & Oil Co., plans the construction of an oil refinery. Estimated cost $500,000. Work will start in January.

Wis., Milwaukee—J. Rauschenberger Co., 30th and Hadley Sts., manufacturers of cordage and twine, will soon award contract for a 1 story, 73 x 340 ft. factory on 30th St. Dick & Bauer, 208 3rd St., are architects.

Wis., Milwaukee—Wrought Washer Co., 46 South Bay St., awarded contract for a 1 story, 150 x 257, 133 x 209 and 96 x 340 ft. factory to Klug & Smith. Estimated cost $175,000.

B. C., Newwestminster — Bloedel, Stewart & Welch Ltd., plans the construction of a shingle mill. Estimated cost $200,000.